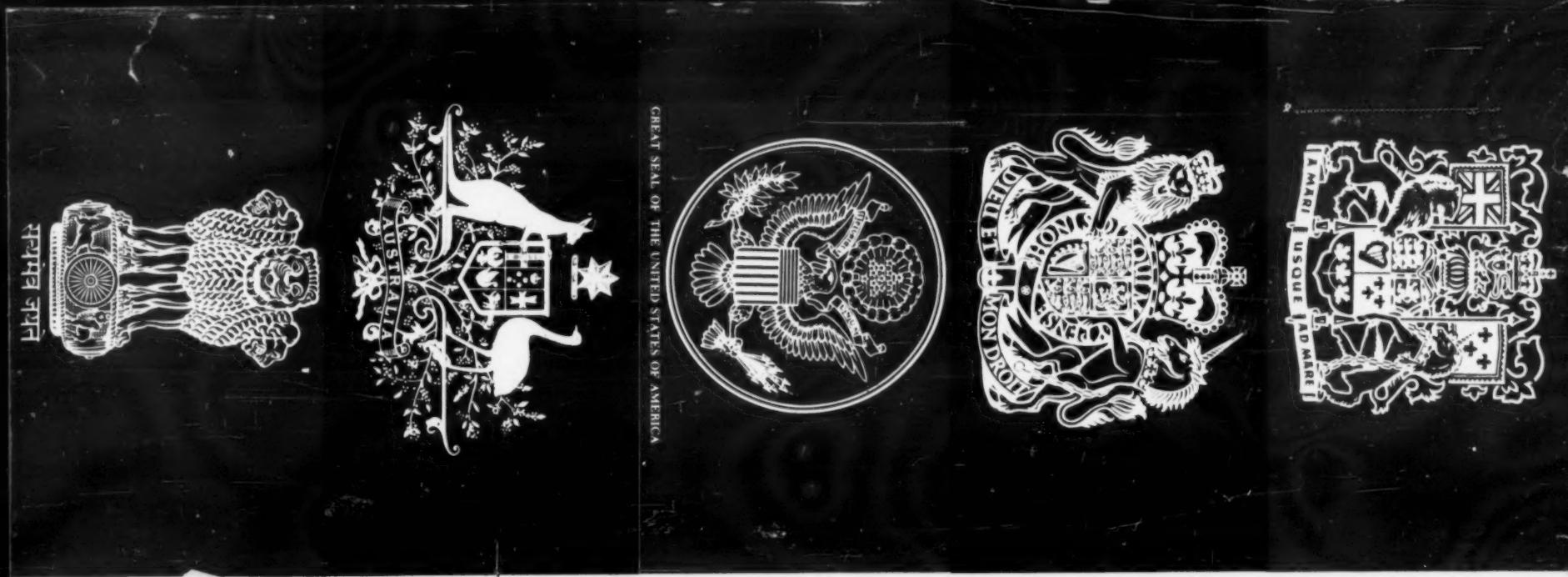

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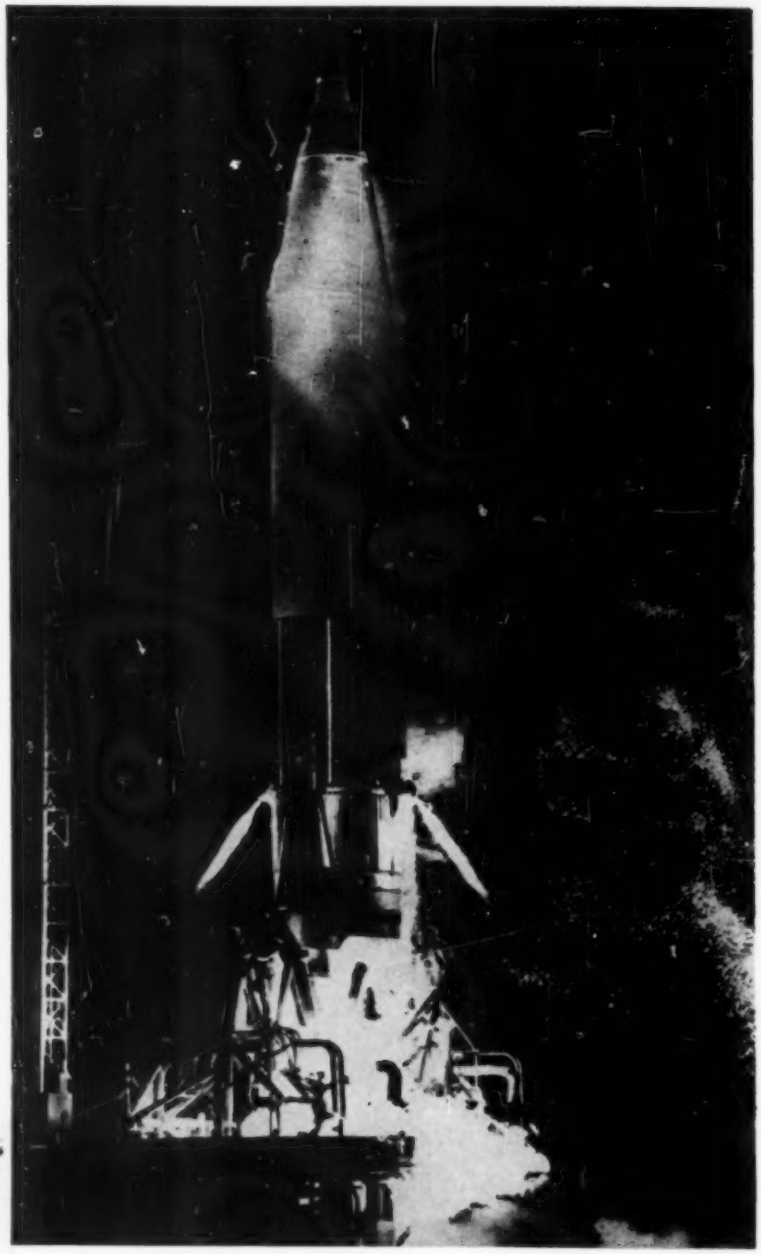
PLATING MAGAZINE

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY · JANUARY · 1961 · INTERNATIONAL ISSUE

"WE PLATE MISSILE CONTACTS WITH SEL-REX BRIGHT GOLD* -AN EXTRA MEASURE OF RELIABILITY"

—Elco Corporation, Philadelphia, Pa.



The failure of a single component can put even the mighty Atlas Missile out of commission. That's why an electroplate of SEL-REX BRIGHT GOLD is specified to give an extra measure of reliability to Elco's patented VARICON Contacts used in missiles, rockets, computers and similar critical applications.

The VARICON Contact, with its fork-like design and 4 coined mating surfaces, offers exceptional resistance to numerous punishing insertions and withdrawals—meeting or surpassing the most exacting specifications. Patented SEL-REX BRIGHT GOLD, which produces a fine grained, dense electroplate—twice as hard as conventional 24K Gold plate — is a major reason for the reputation of quality and reliability enjoyed by VARICON throughout all industry.

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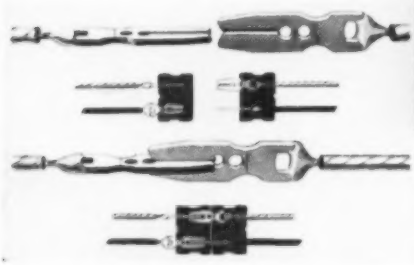

Photo shows Elco's patented Varicon Connectors and unique fork-like contact plated with Sel-Rex Bright Gold.

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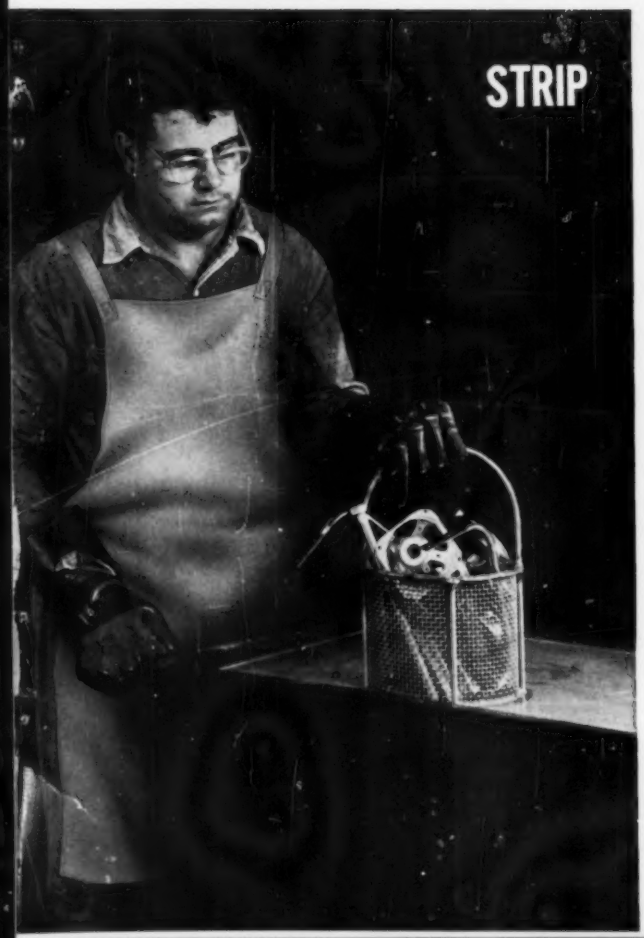

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Newly-developed Enstrip S-60 is a ready-to-use nickel stripper which costs only nickels, not dollars, per pound. And for this low price you also buy convenience, savings in labor. No electric current is required with Enstrip S-60. Just weigh it out, dissolve in water and start stripping nickel, copper, brass, zinc, cadmium or silver plate from steel, iron alloys, magnesium. The powdered alkaline compound, containing cyanide, dissolves faster than metal strippers to which cyanide eggs or bricks must be added.

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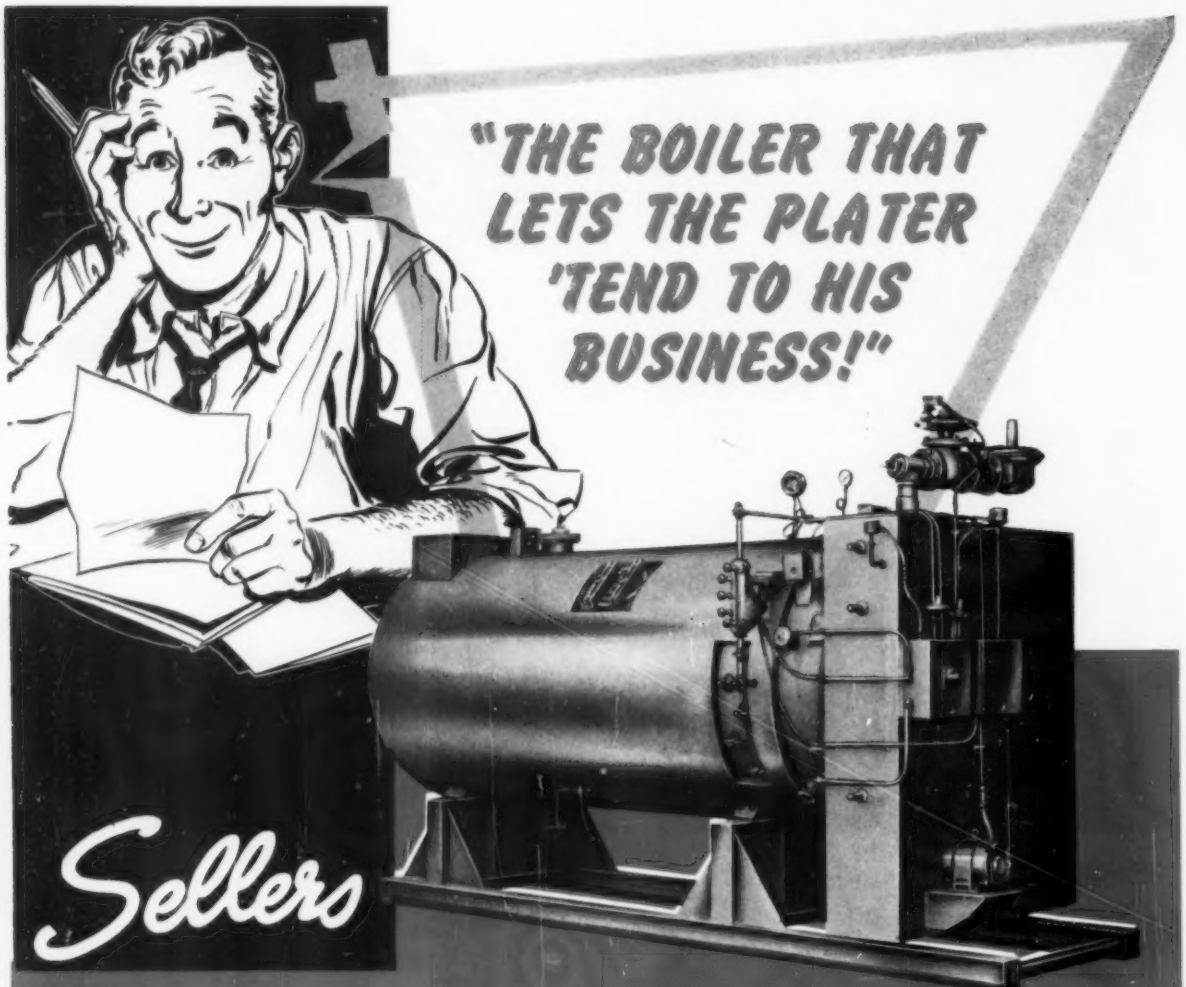

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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY JANUARY 1961 INTERNATIONAL ISSUE

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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

INTERNATIONAL ISSUE

JANUARY 1961 — AUDITED PAID CIRCULATION ABC — **Vol. 48, No. 1**

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EDITORIAL

INTERNATIONAL EXCHANGE

THE CURRENT FAILURES of the great political powers to reach agreement on even minor issues are discouraging until one recalls that it is easy to obtain cooperation throughout the world on any program which has no political overtones. Perhaps the oldest agreement of this sort is the Postal Union which has set the rules for international postal service without fuss or fanfare for nearly one hundred years. In the arts, international exchange flows freely. The score of a Finnish symphony is available equally to musicians in Alaska or Zanzibar. It is written in a language intelligible to both.

Science and technology can benefit by every new advance in knowledge regardless of the country in which it originates. The mission of the American Electroplaters' Society to improve and disseminate knowledge of electroplating, metal finishing and allied arts is not limited to the United States, Canada and Australia. Just as the United Nations Organization provides a forum for the exchange of views of all the nations on their mutual problems, so the AES should and does provide a forum for exchange of knowledge of electroplating, metal finishing and allied arts between workers in this field wherever they may be. We recognize that the obligation to do this is greatest upon that organization whose publications reach the largest number of people in the electroplating and metal finishing industry.

It is true that the International Council performs this function by holding an International Conference on Metal Finishing alternately in Great Britain and the United States. This is a great thing but it happens only once every five years. In the meantime, the AES will continue to encourage workers of all nations to submit technical papers for PLATING MAGAZINE publishing consideration at any time. The Society also makes available all year 'round many technical books in fields of interest to platers and metal finishers at reduced cost to AES members regardless of where they may live.

It should not be amiss to point out that our British cousins of the Institute of Metal Finishing have displayed a laudable international outlook in awarding their highest technical honor, the Hothersall Memorial Medal, to Britons and foreigners alike. While nominations for the AES Scientific Achievement Award are limited to members of the Society of ten or more years standing, they are not restricted as to nationality. Branch delegates will do well to consider nominating scientists who have made the most outstanding advances in metal finishing theory or practice regardless of the country in which they work. Thus will the mission of the AES be best served because international exchange benefits everyone.

W. Andrew Wesley

President
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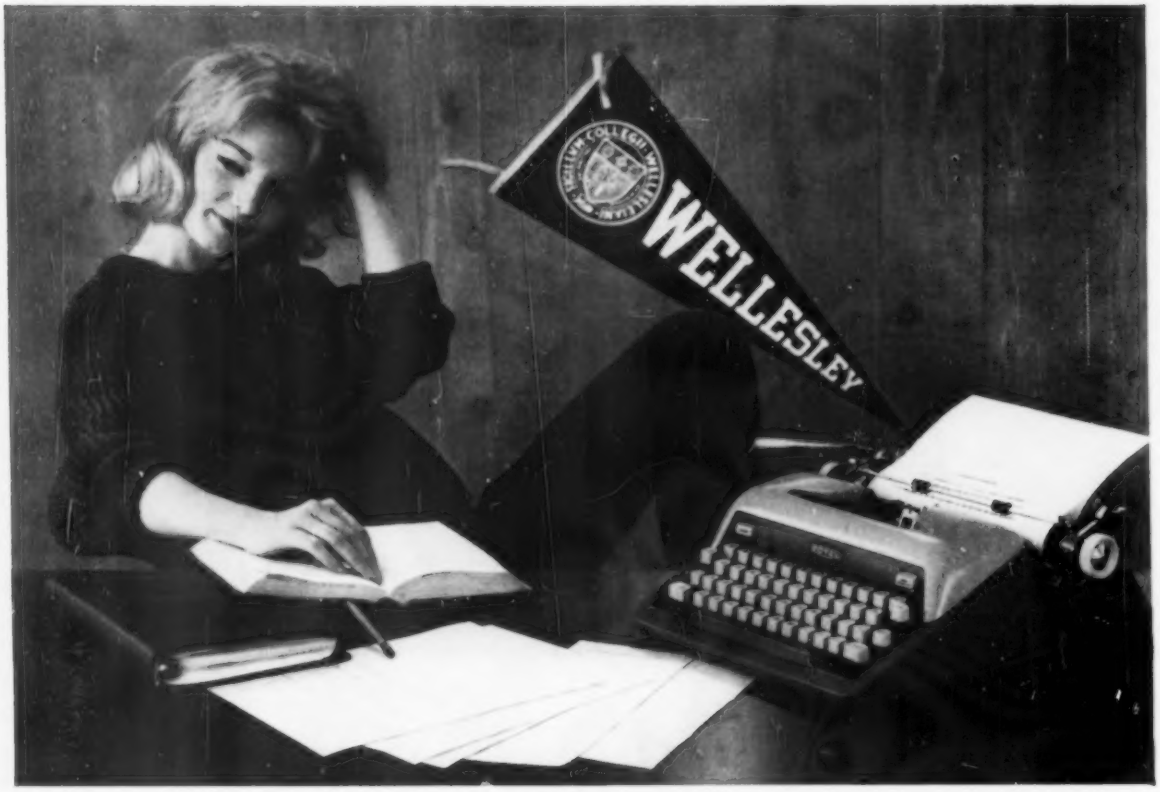

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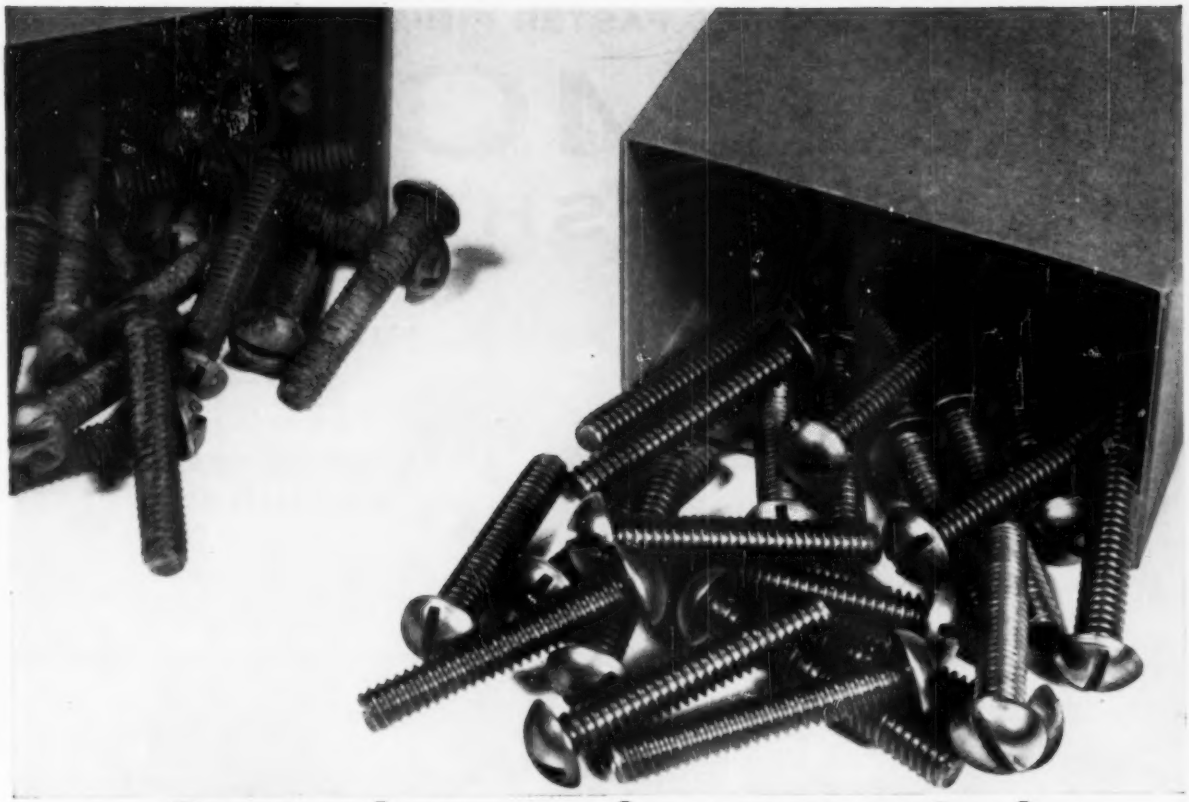

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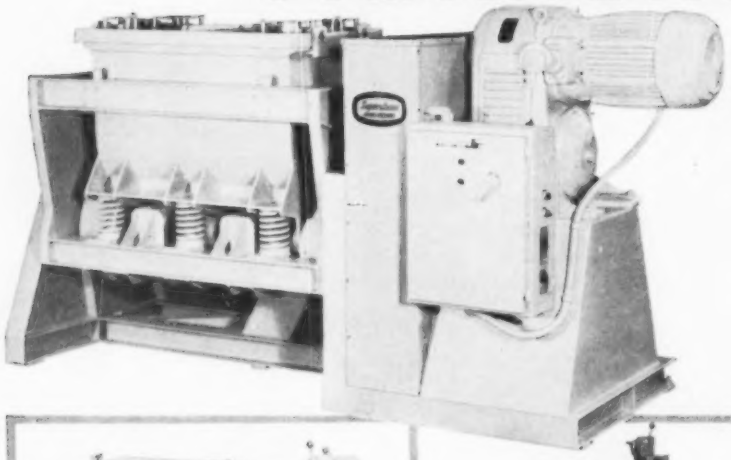

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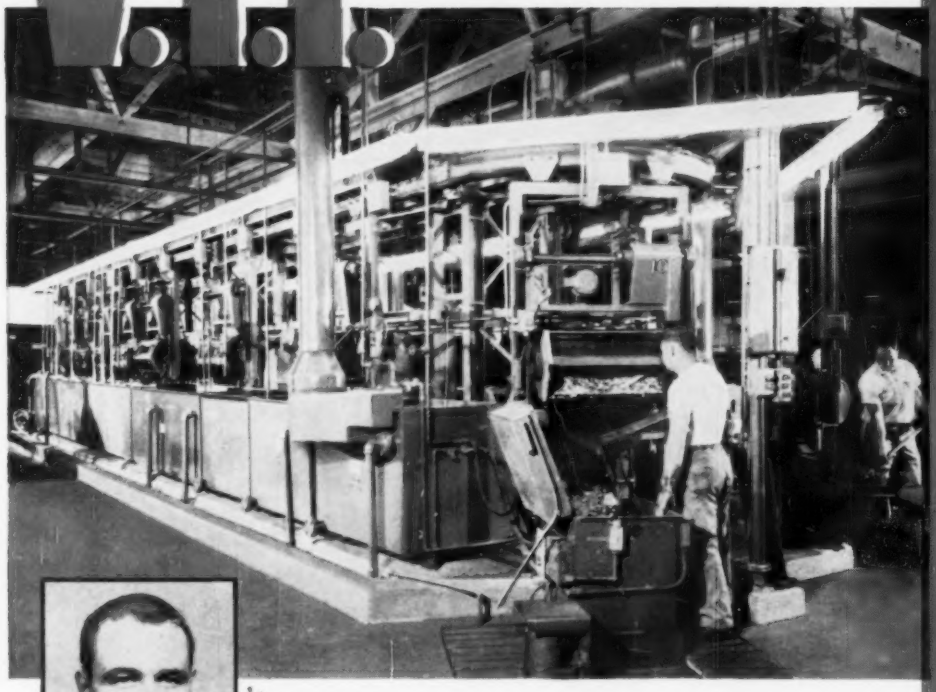

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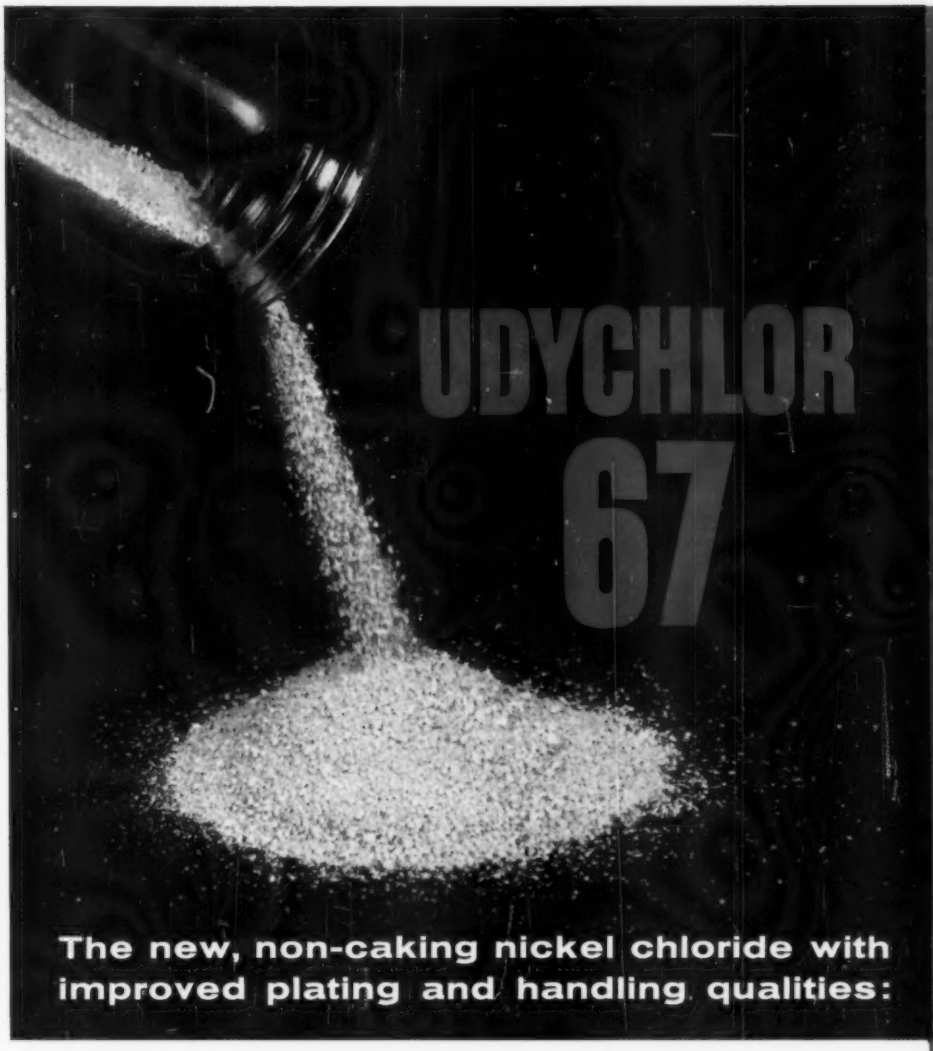

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(1960 EDITION)

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Adhesion of Organic Enamels to Electrodeposited Nickel *by Francis X. Carlin*, The International Nickel Company, Inc., Research Laboratory

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AES PROUDLY ANNOUNCES AVAILABILITY OF ITS INTERNATIONALLY AWAITED 1960 EDITION, "TECHNICAL PROCEEDINGS"

THE INTERNATIONALLY awaited 1960 Edition of the annual book, TECHNICAL PROCEEDINGS, of American Electroplaters' Society, Inc. (AES), published in record time, has now made its appearance, and copies thereof are streaming to AES members in good standing far and wide, here and abroad, for whom the annual book is principally intended. And having accommodated its farflung membership with free copies, AES, the book's exclusive publisher, now has a limited quantity of extra copies available for sale to AES non-members, on strictly a "first come-first served" basis so long as that limited supply lasts, so as to share the book's educational benefits.

Comparable in quality to the GOLDEN JUBILEE EDITION of TECHNICAL PROCEEDINGS (1959 Edition) that earned worldwide acclamation in technical, scientific and other educational circles, AES's 1960 Edition, another treasure chest of knowledge on electroplating, metal finishing, organic coating and allied arts, contains the full text of each of the 31 papers delivered by experts before the 47th Annual Convention of American Electroplaters' Society, Inc., held in Los Angeles, California, July 24-28, 1960.

Embodying, too, the charts, diagrams, graphs, tables and other illustrations of each of the 31 published papers, the book also includes the transcript of the discussion that attended the delivery of each paper. A full list of the papers published in this voluminous repository of education appears on the opposite page of this announcement.

The unique book also includes, among other data, a day-to-day log of the Convention; a section on the AES Scientific Achievement Award and on other AES technical and scientific awards and honors bestowed at that first West Coast National AES Convention; a full listing of the Boards and Standing and Special Committees that served the AES during its fifty-first year, and a complete AES Branch Directory.

HOW TO ORDER YOUR COPY

A limited but fast dwindling extra quantity of the 1960 book has, as stated, been printed to meet the sizable interest shown in it by AES non-members internationally. Orders for copies of the book are now consequently invited from AES non-members, and will be accepted on strictly a "first come-first served" basis so long as that extra supply lasts. The book is unavailable for purchase elsewhere.

Within the continental limits of the United States, the domestic price of this 1960 Edition of AES's TECHNICAL PROCEEDINGS is $18 per copy including postage.

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THE WELLSPRING OF THESE IMPORTANT PAPERS

As a dramatic and fitting climax of its 51st fiscal year, American Electroplaters' Society, Inc. (AES) conducted its outstanding 47th Annual Convention, first West of St. Louis, at the Statler-Hilton Hotel, Los Angeles, California, July 24-28, 1960, with the dynamic Los Angeles Branch, its West Coast pioneer, as Host Branch.

♦

The AES was welcomed to California and Los Angeles by Governor Edmund G. Brown and by Mayor Norris Poulson. The entire week of the AES's Convention was, in fact, proclaimed by Los Angeles's Mayor as "American Electroplaters' Society Week in Los Angeles."

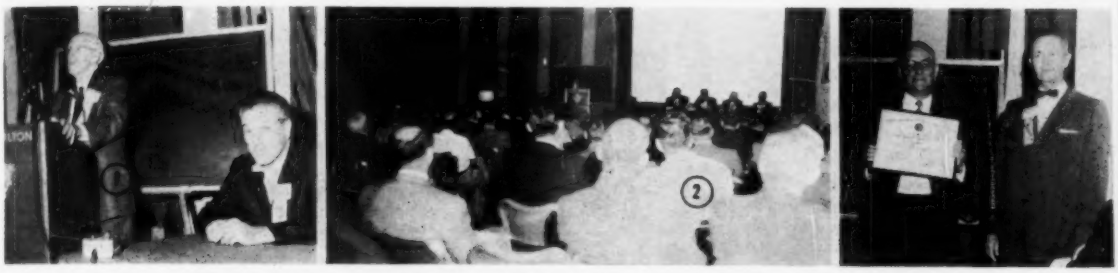
♦

Educational Sessions numbered nine. Experts presented 31 technical and scientific papers enriching knowledge in electroplating, metal finishing and allied arts. One Session alone covered organic finishing.

High spots of the Sessions were not only the second annual "William Blum Lecture" that was delivered as the Educational Program's lead-off attraction by Dr. A. Kenneth Graham, 1959 winner of the "AES Scientific Achievement Award", the Society's highest scientific honor, but also the vaunted two-session, eight-paper "Hydrogen Embrittlement in Metal Finishing Symposium." In addition, this Convention also featured the summary of AES Research Projects presented by AES Research Committee Chairman James D. Thomas at one of the Sessions.

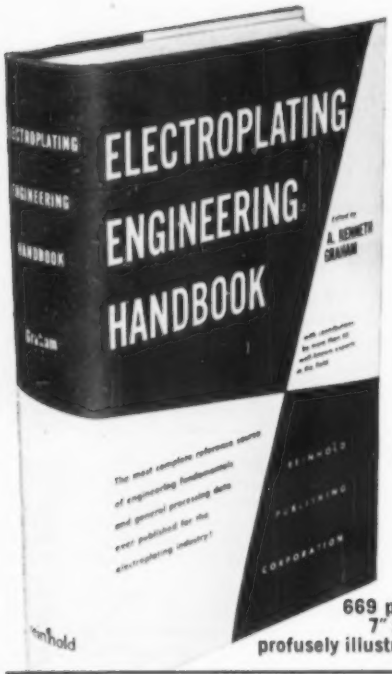
♦

Under the active planning and supervision of the AES's Editorial Board itself, the Educational Sessions were programmed for the AES by Host Branch Educational Chairman Earl W. Arnold and his Co-Chairman, David F. Seymour, with Dr. Harold J. Read of Pennsylvania State University, a special member of that Los Angeles Branch Committee, responsible for the "Hydrogen Embrittlement in Metal Finishing Symposium."



OPENING EDUCATIONAL SESSION HEARS 1960 "WILLIAM BLUM LECTURE"

(1) Dr. William Blum introducing Dr. A. Kenneth Graham, deliverer of the 1960 "William Blum Lecture." (2) Attentive audience hears Dr. Graham discuss "Faraday's Laws Applied to Cleaning." (3) Dr. Graham holds "AES Scientific Achievement Award" scroll presented to him by National President Ralph D. Wysong, right, in behalf of American Electroplaters' Society, Inc.



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Here are a few excerpts from a review in *Research and Engineering:* "The book is very well written, remarkably free from typographical errors, and shows an excellent appreciation of the problems encountered by the practitioner in the selection of tables and topics covered . . . much attention is paid to definition of all terms used, and it appears that special attention must have been directed toward making each presentation easy to understand . . . The editor and his associates are to be complimented on a fine job, resulting in a volume which may be recommended to all who are associated with the engineering aspects of electroplating."

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"WE HAVE a record in this part of the U. S. Department of Commerce, of some 5000 National Association and Societies. Your volume is one of the finest reports of its type which we have had the pleasure of seeing prepared by an Association." Thus did one agency evaluate the Golden Jubilee Edition of the book TECHNICAL PROCEEDINGS (1959) of American Electroplaters' Society, Inc. (AES), its exclusive publisher. And having accommodated its membership with free copies, AES now has a limited number of extra copies available for sale to AES non-members so as to share the book's educational benefits.

The unique book contains the full text of each of the 43 technical papers on electroplating, metal finishing, organic coating and allied arts by experts of nine countries, including the United States, England, Canada, Australia, France, Germany, Holland, India and Italy, delivered before the Fifth International Conference on Electrodeposition and Metal Finishing, educational sessions element of the AES's Golden Jubilee Convention held in Detroit, Michigan, June 15–19, 1959.

Embodying, too, the charts, diagrams graphs, tables and other illustrations of each of the 43 published papers, *the book also includes the transcript of the discussion that attended the delivery of each paper.* A full list of the papers published in this voluminous treasure chest of knowledge has been carried in past issues of PLATING MAGAZINE since December 1959, and will gladly be sent to you on request.

Spanning some 400 pages (by far the largest annual TECHNICAL PROCEEDINGS ever published by the AES in its half-century lifetime), this 1959 edition also includes, among other data, a day-to-day log of the Golden Jubilee Convention; a section on the AES Scientific Achievement Award and on other AES technical and scientific awards and honors bestowed at the Golden Jubilee Convention; a full listing of the Boards and Standing and Special Committees that served the AES during its Fiftieth Anniversary year, and a complete AES Branch Directory.

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INTERNATIONAL CONFERENCE: ITS AES HALF-CENTURY SETTING

DRAMATIC and fitting climax of its year-long FIFTIETH ANNIVERSARY observance, American Electroplaters' Society, Inc. (AES) conducted its unique Golden Jubilee Convention and Industrial Finishing Exposition, including the concurrent Fifth International Conference on Electrodeposition and Metal Finishing, in Detroit, Michigan, June 15-19, 1959.

GREETED by the President of the United States, the AES was welcomed to Michigan and Detroit by Governor G. Mennen Williams. The entire week of the AES's Convention, Exposition and International Conference was proclaimed by Detroit's Mayor as "AES GOLDEN JUBILEE WEEK IN DETROIT."

AS the Fifth International Conference on Electrodeposition and Metal Finishing, the Golden Jubilee Convention's educational sessions numbered eleven. Experts from nine countries, including the United States, England, Canada, Australia, France, Germany, Holland, India and Italy, presented 43 technical and scientific papers enriching knowledge in electroplating, metal finishing and allied arts. High spot of the sessions was the first "William Blum Lecture" that was delivered by the eminent Dr. William Blum, first winner of the AES Scientific Achievement Award, the Society's highest honor.

UNDER the supervision of the AES's Editorial Board, in collaboration with the International Council on Electrodeposition and Metal Finishing, the International Conference was planned for the AES by AES Past President Walter L. Pinner, Chairman of the International Council. His Committee included Dr. T. P. Hoar, Dr. Simon Wernick, A. W. Wallbank, R. A. F. Hammond and George Gardam of England and Myron B. Diggin, Dr. Walter R. Meyer and Dr. Richard B. Saltonstall of the United States.

OPENING SESSION OF THE FIFTH INTERNATIONAL CONFERENCE ON ELECTRODEPOSITION AND METAL FINISHING

(1) Chairman Walter L. Pinner extending official welcome. Dr. William Blum, AES Scientific Award winner, seated. (2) Crowded auditorium at the first session. (3) Session Chairman T. P. Hoar introducing Dr. Blum, who delivered the first William Blum Lecture.

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Loose Abrasive Finishing Machines by *Fred T. Hall*, General Motors Corporation

AES Project No. 14—The Influence of Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating
V: Effect of Polishing on the Durability of Nickel Plated Mild Steel by *Dr. Maurice H. Jones and J. Zajdowski*, Ontario Research Foundation

Metal Wastes—Contribution and Effect—Cincinnati Metropolitan Sewage Disposal Service Area by *Fenton H. Dobb*, City of Cincinnati (Sewage Disposal Section)

Ion Exchange and the Pickling of Magnesium Sheet by *Robert E. Anderson*, The Dow Chemical Company

The Use of Bioassays in the Safe Disposal of Electroplating Wastes by *Dr. Charles M. Tarzwell*, Robert A. Taft Sanitary Engineering Center

Industrial Waste Treatment and Water Reclamation—A Case Study by *Wayne L. Gaspar*, The Maytag Company

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President and Technical Director, Electrochemical Industries, Inc.

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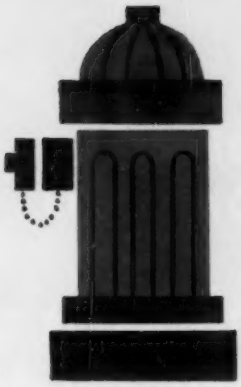

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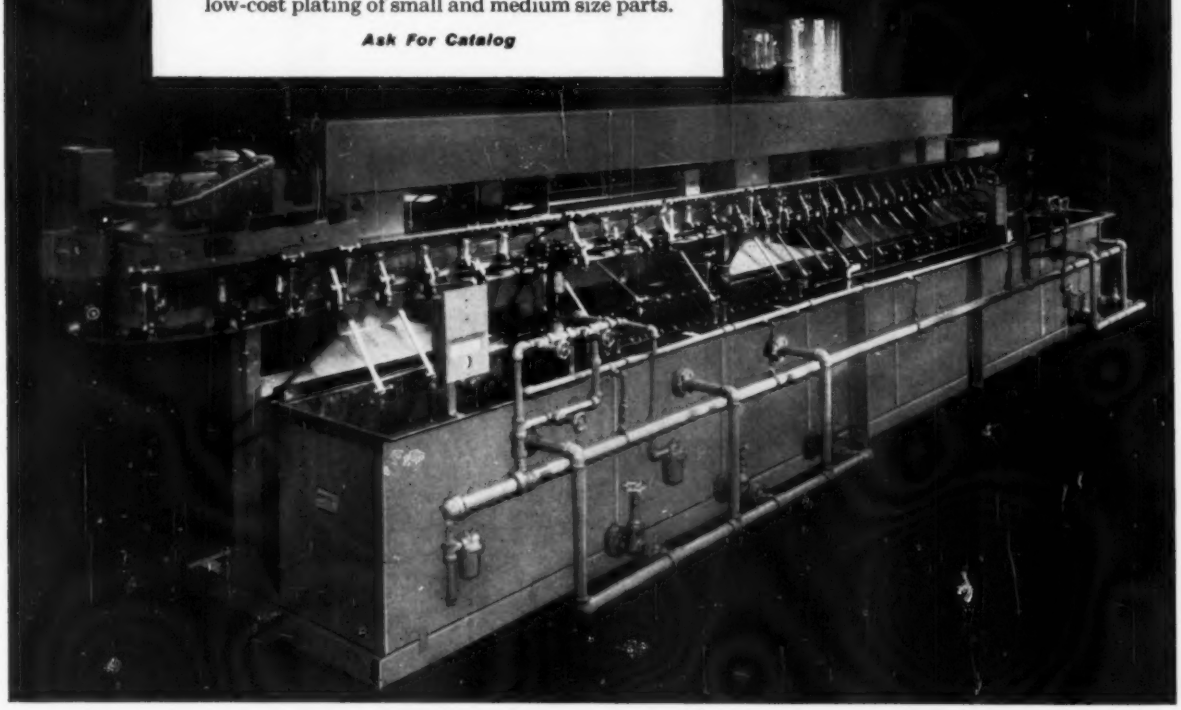

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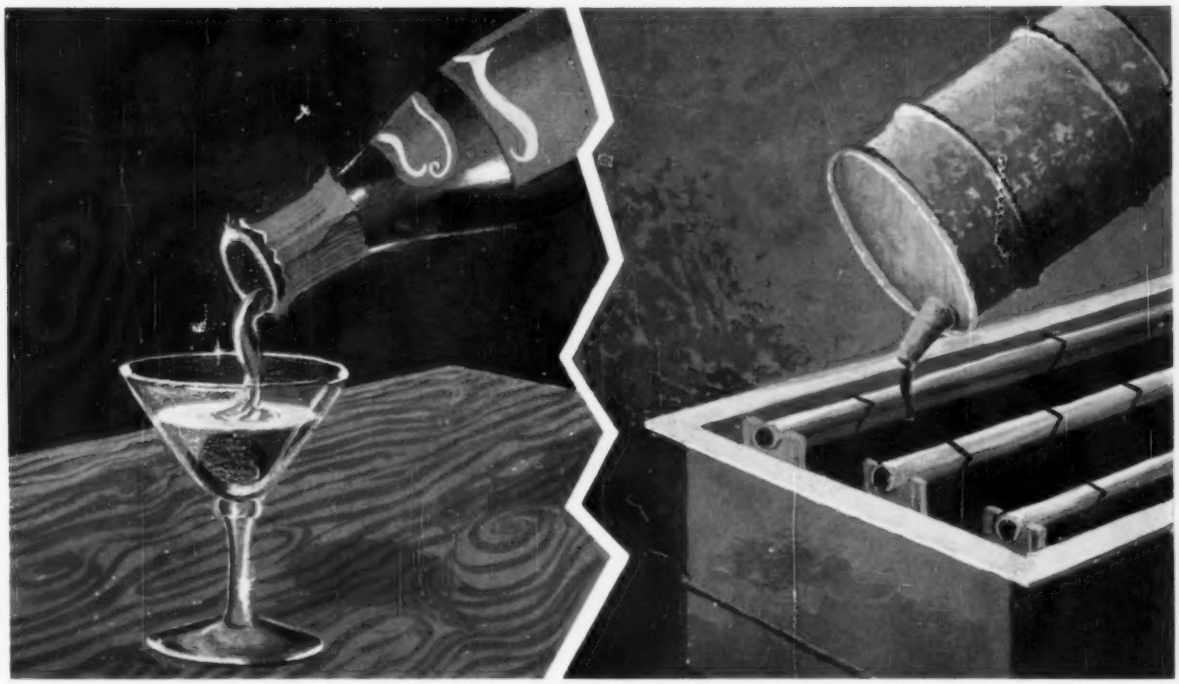

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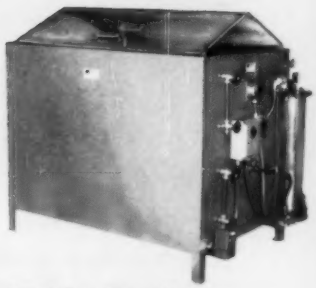

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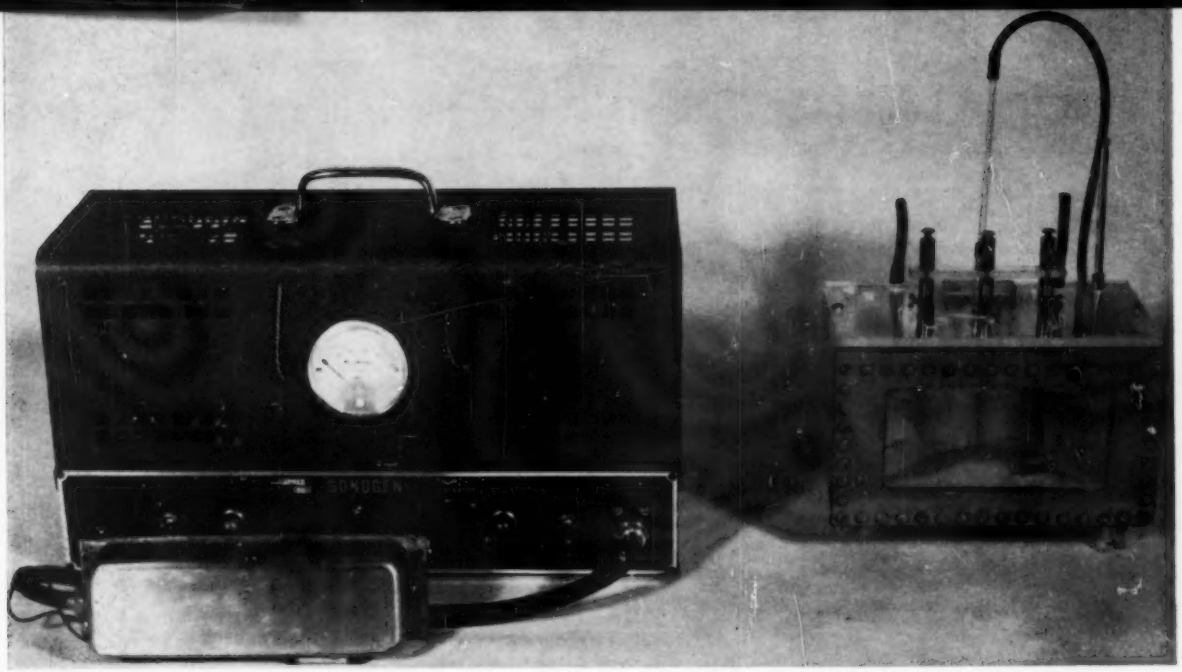

Fig. 1. Acoustical system used in this investigation showing ultrasonic generator and transducer assembly and polyethylene cell with acoustical window.

EFFECTS OF ULTRASONICS ON ELECTROLYTIC DEPOSITION OF COPPER FROM A CYANIDE BATH

by CHARLES B. KENAHAN* and DAVID SCHLAIN**

ABSTRACT

The application of ultrasonics in the electrolytic deposition of copper from a simple, low-temperature cyanide bath resulted in large increases in anode and cathode current efficiencies, accompanied by large decreases in cell voltage. The relationship of these effects to current density is discussed, and the effectiveness of ultrasonic vibrations and mechanical agitation are compared. Electrode potential studies indicated that the decrease in cell voltage resulted chiefly from depolarization at the anode.

INTRODUCTION

CONSIDERABLE INTEREST has developed in recent years in applying high-frequency sound waves (ultrasonics) to industrial processing. At the present time, ultrasonics is frequently used in cleaning, testing, machining, and degreasing. There have been many suggestions for using sound energy in chemical processing, but additional information on its effects is needed. The Bureau of Mines is engaged in research designed to evaluate the effects of high-frequency sound waves on the electrolytic deposition of certain metals from aqueous solutions.

Examination of the literature reveals some interesting and important results when ultrasonic vibrations are applied to the electrodeposition of various metals. Some of these effects include improvement of physical properties,[1] imprint of half-wave patterns on the cathode surfaces,[2] formation of metallic powders instead of coherent deposits,[3] influence on crystal orientation and grain size,[4, 5] and an increase in current efficiency.[6]

* Chemist, Bureau of Mines, U.S. Department of Interior, College Park Metallurgy Research Center, College Park, Md.

** Chemical engineer, Bureau of Mines, U.S. Department of Interior, College Park Metallurgy Research Center, College Park, Md.

This investigation deals with the influence of high-frequency sound waves on the electrodeposition of copper from a simple, low-temperature cyanide bath. Data are presented on the effects of ultrasonic radiation on anode and cathode current efficiencies and on cell voltages at a series of current densities.

Potential studies at the anode and cathode were conducted to determine the effects of ultrasonic radiation on electrode polarization and anode passivity.

APPARATUS AND EXPERIMENTAL TECHNIQUES

The acoustical system used in this work consisted of an electrolytic cell and transducer assembly immersed in a constant temperature water bath at 35C, and an ultrasonic generator (Figs. 1 and 2). The cell was fabricated from ½ inch thick high-temperature polyethylene and had a 3- by 6- by 0.005-inch thick mylar window in one side to permit efficient transmission of the sound energy. The cell was 7½ inches long, 4 inches deep, and 4½ inches high on the inside. It contained two anodes, one cathode, and 2000 milliliters of electrolyte. A glass cooling coil was located in the cell, on the side opposite the mylar window. The cell top was made from ¼ inch plexiglas. The barium titanate transducer was encased in a water-tight, stainless steel shell and was located

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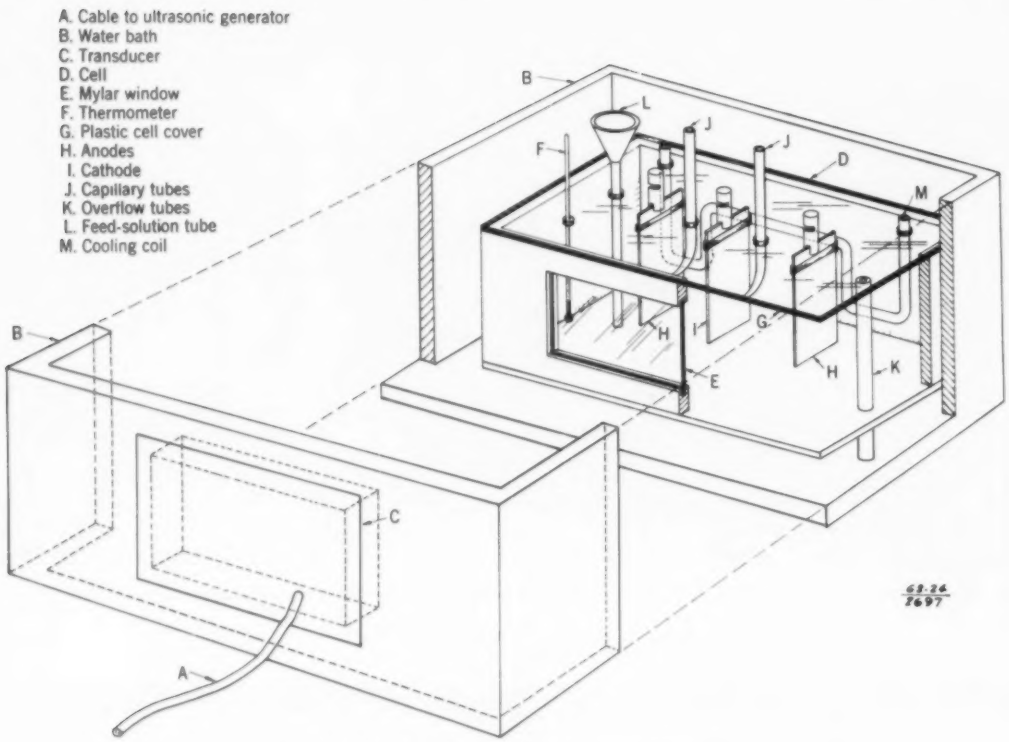

Fig. 2. Schematic diagram of acoustical system.

in front of the mylar window and one inch from it (Fig. 2). The effective radiating surface of the transducer was 7½ by 2 inches. The faces of the electrodes were perpendicular to the radiating surface of the transducer so that the sound waves passed parallel to them.

The anodes were fabricated from copper sheet which contained a minimum of 99.9 per cent copper, and the cathodes, except as noted, were reagent-grade copper foil. An electroplating stopoff lacquer was used to insulate portions of the electrodes. The ratio of anode area to cathode area was 2:1 (8 square inches:4 square inches). Anode-to-cathode spacing was 1.5 inches. Fresh electrodes were used in each electrolysis. The surfaces were sanded with 3/0 emery cloth, rubbed with wet pumice, rinsed with distilled water, dried, and were given a final wash with carbon tetrachloride. The electrodes were weighed before and after electrolysis, and current efficiencies were calculated from the changes in weights.

Reagent-grade chemicals were used in preparing the electrolyte which contained the following chemicals, in grams per liter: cuprous cyanide (CuCN), 22.5; sodium cyanide (NaCN), 34.0; and sodium carbonate (Na_2CO_3), 15.0.[7] The *p*H of the solution was adjusted to 12.0 by adding sodium hydroxide, and it changed less than 0.1 of a *p*H unit during use. Fresh solution was fed into the cell at the rate of 5 milliliters per minute. This provided a small amount of circulation. The overflow solution was not reused. No more than six deposits were made with the same cell solution. At intervals, when the used cell solution was replaced with a fresh one, a duplicate electrolysis was performed. No significant differences were noted when the results of these experiments were compared. To eliminate the effects of any changes in the cell solution during use, experiments with and without ultrasonic radiation were alternated in the schedule.

The ultrasonic generator used in this work had an average radiofrequency power output of 125 watts at a frequency of 38 kilocycles per second. The transducer had a resonant frequency of 38 kilocycle. per second.

Electrode potentials and cell voltages were measured at a series of constant current densities while the deposition was in progress. The current density was based on the geometric area of the cathode. A Luggin-type capillary tube (see Fig. 2) was used to obtain electrode potentials and was arranged in such a manner that it could be removed from the electrode surface after each reading. The tip of the capillary tube made contact near the center of the exposed electrode surface. Electrode potentials were measured with an L&N type K-2 potentiometer, a saturated calomel electrode, and a saturated potassium chloride bridge. Potentials were referred to the standard hydrogen scale and were rounded off to the nearest hundredth of a volt.

Acoustical intensities* were calculated from pressure amplitudes as determined with a barium titanate probe and a Ballantine vacuum tube voltmeter. The sensing element of the probe was $\frac{1}{16}$ inch long and 0.058 inch in diameter. The calibration of the probe was made with its axis perpendicular to the sound wave, and its most sensitive portion toward the sound source. The significance of this type of intensity determination is limited because of the non-uniformity of the acoustic field inside the cell. This is the result of a number of effects, including refraction and diffraction, the reflection of the sound energy by the electrodes, the geometry of the cell, and attenuation of the sound waves by the gas-type cavitation

* The sound intensity used in this work was above cavitation level. Acoustical intensity (I) is related to RMS pressure (p) by the equation $I = \frac{p^2}{\rho c}$, where ρc is the characteristic impedance of the solution.

TABLE I

ELECTRODEPOSITION OF COPPER FROM A SIMPLE COPPER CYANIDE SOLUTION, 1 HOUR DEPOSITS 35C, WITH AND WITHOUT ULTRASONIC RADIATION, FREQUENCY 38 KC PER SECOND, ACOUSTICAL INTENSITY 0.25 WATT PER SQUARE CENTIMETER

Cathode, current density, amp/sq ft	Cathode, current efficiency, per cent		Anode, current efficiency, per cent		Final cell voltages, volts	
	Normal	With radiation	Normal	With radiation	Normal	With radiation
5	53.4	86.2	107.0	112.0	1.28	0.90
10	32.5	73.7	102.0	107.0	1.48	1.04
15	27.7	73.2	*	101.0	2.23	1.14
20	18.1	56.7	*	101.0	2.45	1.21
30	14.2	50.0	*	101.0	2.63	1.41
40	14.2	52.1	*	101.0	2.77	1.58
50	13.9	43.3	*	102.5	2.93	1.73
60	8.3	25.0	*	103.0**	3.03	1.84**
				5.2		2.71
70	6.8	19.0	*	6.9	3.26	2.92
80	7.6	18.7	*	6.1	3.31	3.11
90	6.2	15.6	*	5.3	3.46	3.25
100	10.5	22.2	*	***	3.58	3.35

Note: Most of the values in the table represent an average for two or more 1-hour experiments.

* No anode corrosion.
** Results of 2 experiments; anodes were quite passive in one and corroded in the other.
*** Both anodes were passive; one lost 0.03 gram; one gained 0.13 gram.

bubbles which formed in the cell. Results of intensity measurements made in the water bath next to the mylar window and inside the cell show that loss in power through the acoustical window was negligible. A large number of sound intensity measurements were made during the investigation and the intensity value expressed below is within the limits of the calculated output of the acoustical system used.

EXPERIMENTAL RESULTS

The data in Table I and Figure 3 show the effects of ultrasonic radiation at a frequency of 38 kilocycles per second and an intensity of 0.25 watt per square centimeter,* on the cathode and anode current efficiencies and on cell voltages at a series of current densities.

Without ultrasonic radiation (normal operation), the cathode current efficiency decreased with increasing cathode current density. Current efficiencies decreased from 53 per cent at 5 amp/sq ft, to 10 per cent or less at current densities of 60 to 100 amps.** Irradiation with high-frequency sound waves increased the cathode efficiency at every current density used. The largest increases (to 73 per cent) occurred at current densities of 10 and 15 amp/sq ft. At the higher current densities, the effect of radiation was not as great.

* 0.25 watt per sq cm in any plane parallel to the transducer face.
** In industrial plating, this type of bath is used at current densities of 10 to 15 amp sq ft, and cathode current efficiencies of about 30 per cent are obtained.[7] Data presented here are consistent with this.

During normal cell operation, the anodes corroded at current densities of 5 and 10 amp/sq ft, but stopped corroding (i.e., became passive), when the cathode current density was increased to 15 amps. When the anodes were irradiated, anode current efficiencies were more than 100 per cent up to a current density of 50 amp/sq ft. At 60 amps, anode current efficiencies were erratic; at higher current densities the efficiencies were less than 10 per cent.

Cell voltage increased with increasing current density both with and without ultrasonics. Without ultrasonic radiation, there was a particularly large increase in cell voltage when the current density was raised from 10 to 15 amp/sq ft. Ultrasonic radiation lowered the cell voltage at every current density. Furthermore, it prevented the sudden increase in cell voltage which normally occurred between 10 and 15 amps. The decrease in cell voltage arising from the use of ultrasonic radiation was especially large between current densities of 15 to 60 amp/sq ft (about one volt). Above 60 amps, radiation had less effect.

A macroscopic examination of all the copper deposits made with and without ultrasonic radiation, immediately after deposition, showed a bright, smooth, adherent deposit up to a current density of about 50 amp/sq ft. At this point, the deposits began to develop small burrs or trees and were not as bright. Microscopic examination revealed that the crystal aggregates formed in an ultrasonic field were more symmetrical than those formed under normal circumstances. Grain size decreased as current density increased, both with and without radiation, but smaller grain size occurred when the cathode was irradiated. X-ray diffraction studies showed no significant degree of preferred orientation either with or without radiation.

This random orientation is contrary to the findings of Wolfe and others,[8] who noted a marked increase in preferred orientation when copper was deposited from an acid copper sulfate solution in an ultrasonic field. However, in the bath used in the present investigation, there is rapid evolution of hydrogen and low current efficiencies, especially at the higher current densities. These conditions tend to result in random deposits.

To explain the large changes in cell voltage and current efficiencies noted, potential measurements were made at the electrodes. Time-potential curves were obtained for the cathode and anode as the cathode current density was varied stepwise from 5 to 100 amp/sq ft. Because the initial readings changed so rapidly, potential data at the anode and cathode were obtained in separate tests. Normally, the cathode polarized (became less noble) rapidly at all current densities and then gradually leveled off to a steady-state potential.

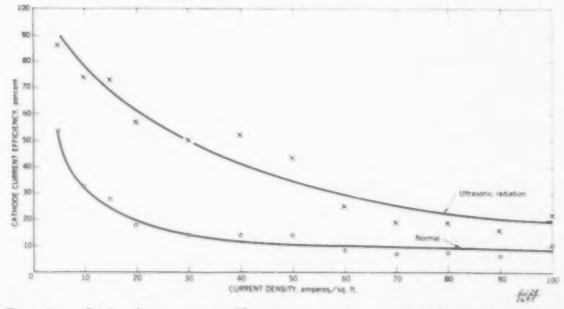

Fig. 3. Cathode current efficiency versus current density, copper cyanide electroplating solution, 35C; ultrasonic radiation, frequency 38 kilocycles per second, acoustical intensity 0.25 watt per square centimeter.

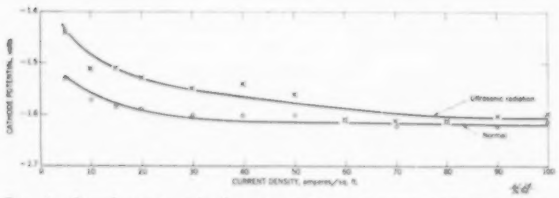

Fig. 4. Steady-state cathode potential versus current density, copper cyanide electroplating solution, 35C; ultrasonic radiation, frequency 38 kilocycles per second, acoustical intensity 0.25 watt per square centimeter.

Ultrasonic radiation very quickly depolarized the cathode and generally resulted in a slightly less polarized steady-state potential (more noble).

Radiation did not greatly change the shapes of the cathode time-potential curves, except during the first few minutes.

Wolfe and others,[8] using Schlieren techniques and working with copper sulfate solutions, attributed this rapid initial depolarization at the cathode to disruption of concentration gradients by the ultrasonic waves. These workers related this effect to the micro-agitation action of the sound waves.

Time-potential data at the anode showed that, during normal cell operation, the anode polarized rapidly (became more noble) and then gradually came to a steady state. The effect of ultrasonic radiation was to decrease the amount of polarization. When irradiated with sound energy, the anode potential generally remained constant up to a current density of 50 amp/sq ft. Beyond this, radiation did not greatly alter the shape of the anode time-potential curves.

Figure 4 shows that ultrasonic radiation made the steady-state values of the cathode potential more noble (caused depolarization) at all current densities from 5 to 100 amp/sq ft. The effect of radiation was greater at the lower current densities but was not large at any current density. Radiation did not change the shape of the current density-potential curve and both curves appear to approach a limiting value.

Cathode potential versus current density curves were also plotted using potential readings taken during the above experiments at the end of 300 seconds (not shown). Although these potential values differed slightly from those taken at the end of one hour (Fig. 4), the shapes of the curves and the effect of ultrasonic radiation were virtually the same.

In another series of one hour electrolyses at a current density of 15 amp/sq ft, a steel electrode (SAE 4130) was substituted for the standard copper cathode. The initial potential readings of the steel cathodes were more noble, but the steady-state values and the effects of ultrasonic radiation were similar to those obtained with copper cathodes.

Figure 5 presents curves relating the steady-state anode potential to current density at cathode current densities of 5 to 100 amp/sq ft. In the absence of ultrasonic radiation, there was a sharp increase in the steady-state value of the anode potential (more polarization) up to a current density of 20 amp/sq ft. At current densities above this, the anode potential did not change much with increasing current density. Ultrasonic radiation resulted in a less noble anode potential (less polarization) at all current densities. This effect was very large at current densities of 15 to50 amps (more than one volt). In several experiments at 60 amps (with radiation), the anode polarized and became passive; the steady-state potential was quite noble. In other experiments at 60 amps, the anode remained active (corroded) and the potential was much less noble. The current density range in which this occurs is indicated on the graph by shading. The anode was always passive at a current density of 70 amps.

In normal cell operation, the anode became passive and stopped corroding at a current density of about 15 amp/sq ft. This was accompanied by the formation of a heavy bluish-black film on the anode. In the early stages of formation, this film was tinged with gray. X-ray diffraction analysis identified it as cupric hydroxide. The film became thicker and darker with increasing current density, and at 50 amp/sq ft it amounted to about 0.25 gram per anode (Fig. 6B). Ultrasonic radiation prevented the formation of this film and the passivity which accompanies it, at least up to a current density of 50 amp/sq ft (Fig. 6A). This appears to be the limiting current density at which radiation consistently prevents anode passivity. Although a visible black cupric hydroxide film sometimes formed at a current density of 60 amp/sq ft in the presence of ultrasonic radiation, it did not obscure the entire anode surface until a current density of about 100 amps was reached.

Miller[9] observed a sudden jump in cell voltage when working with a copper cyanide bath and using copper electrodes. He correlated it to a poorly conducting film on the anode. Read and Graham[10] also noted the formation of a passive film on copper-iron anodes in a copper cyanide solution.

In an attempt to compare the effects of ultrasonic vibrations with mechanical agitation, the standard copper cathode was replaced with copper sheet and was rotated during electrolysis by an electric stirrer; this also produced considerable agitation at both anodes. At a current density of 50 amp/sq ft, mechanical agitation, produced by rotating the cathode at 200 revolutions per minute, did not prevent formation of the passive film on the anodes (Fig. 6C). At 300 revolutions per minute, the film was barely visible (Fig. 6D); however, the anodes did not corrode and the cell voltage was high. At a current density of 15 amp/sq ft, rotating the cathode at 300 revolutions per minute produced results approaching those obtained with ultrasonic radiation; at 30 amp/sq ft mechanical agitation was much less effective. The electrolyte became cloudy when agitated in this manner, whereas it always remained clear when ultrasonic radiation was employed. Apparently, ultrasonic radiation results in a unique type of agitation that cannot be equalled by ordinary mechanical means.

During the experiments in which the cathode was rotated at 300 revolutions per minute, the cathode current efficiencies were higher than normal, but they were less than those ob-

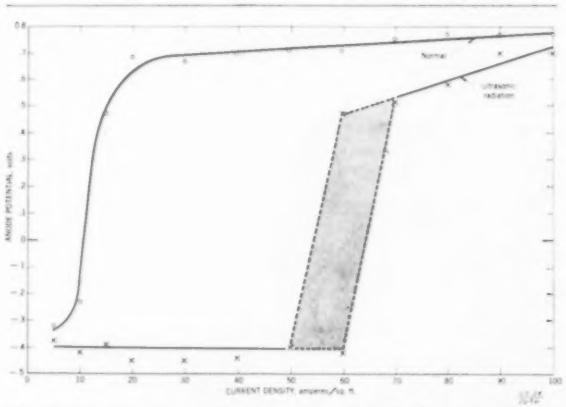

Fig. 5. Steady-state anode potential versus cathode current density, copper cyanide electroplating solution, 35C; ultrasonic radiation, frequency 38 kilocycles per second, acoustical intensity, 0.25 watt per square centimeter.

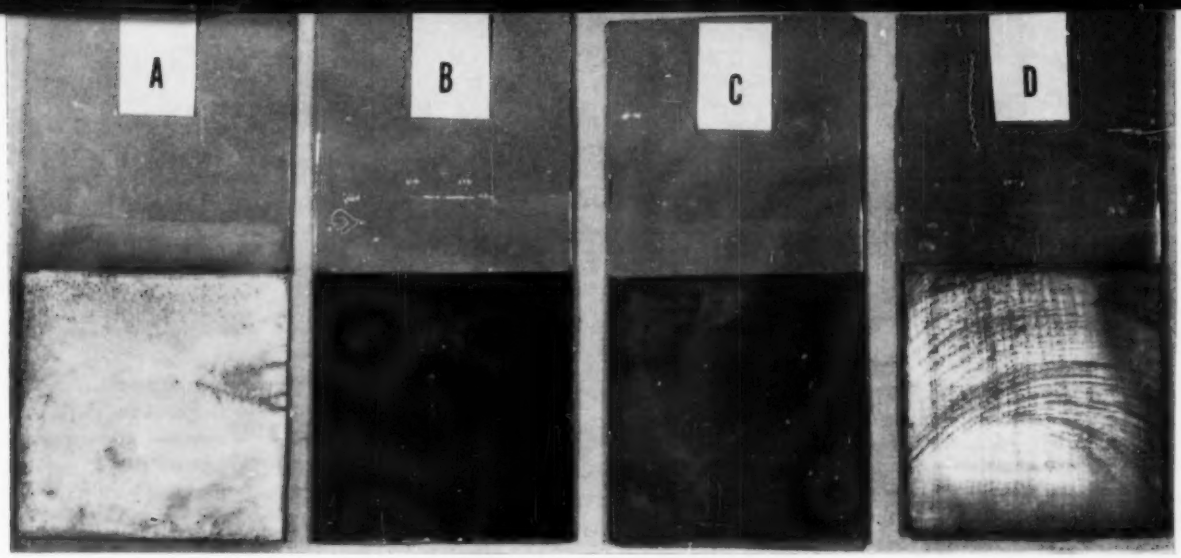

Fig. 6. Appearance of anode surfaces after electrolysis had continued for 1 hour. Active anode area 2 x 2 inches. Cathode current density was 50 amperes per square foot in each case. A. Ultrasonic radiation frequency, 38 kilocycles per second, acoustical intensity 0.25 watt per square centimeter. B. Normal. C. Stirring (200 rpm). D. Stirring (300 rpm).

tained with ultrasonic radiation. For example, at a current density of 15 amp/sq ft, ultrasonic radiation resulted in a current efficiency of 73 per cent, mechanical agitation 60 per cent, and normal operation 28 per cent At 50 amps, radiation resulted in an increase of 18 per cent over mechanical agitation.

SUMMARY

Several effects of ultrasonic radiation in the electrodeposition of copper from a simple cyanide plating bath have been described and the following conclusions were reached:

(1) Ultrasonic radiation resulted in large increases in cathode current efficiencies and in large decreases in cell voltages over a wide range of current densities. It substantially raised the current density at which the anode normally becomes passive.

(2) Ultrasonic radiation had a small depolarizing action at the cathode at any current density (<0.1 volt). This effect is probably due to the intense micro-agitation (caused by cavitation) which disrupts the concentration gradients.

(3) The depolarizing action of radiation at the anode is large (>1.0 volt). Presumably, this is the result of the cleaning or scrubbing action (cavitation) of ultrasonic waves in removing the cupric hydroxide film that tends to form on the anode surfaces. This film is accompanied by passivity.

(4) Ultrasonic agitation is more effective than conventional agitation.

(5) Ultrasonics may also have applications in other specialized plating processes where conventional stirring is impossible or ineffective.

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THE EFFECT OF SEALING IN LABORATORY CORROSION TESTS OF ANODIZED ALUMINUM

A Short Study

by W. E. COOKE and R. C. SPOONER*

INTRODUCTION

FOR AESTHETIC APPLICATIONS of aluminum, such as architectural components or automotive decorative bright trim, the major function of anodizing is to produce the desired attractive surface finish and to retard changes in the appearance during service exposure. Correct processing is required to yield optimum performance. Adequate film thickness and sealing are two major requirements. Inadequate preparation contributes to the following effects in service application.

Staining and Bloom
Weathering Attack including Pitting
Mechanical Damage
Colour Fading

The anodic film may become stained, or develop over the whole exposed area an unattractive non-uniform whitish cast commonly described as "bloom," if it has not been sealed properly. This operation, generally the final step in the anodizing procedure, consists of treatment in boiling water or metal salt solutions during which the oxide film becomes partly hydrated, particularly on its surface. This markedly affects the chemical and physical properties of the film, for instance it greatly reduces the porosity. Laboratory tests for anodic films should therefore, include a procedure to measure the efficiency of sealing.

Exposure to outdoor environment causes slow weathering attack. In urban and industrial environments this is characterized by the formation of pits which generally are of the "clean" type, that is, there is very little local staining around the pit. An accelerated laboratory test to reproduce this type of pitting attack is a prerequisite for predicting the service behaviour in contaminated atmospheres. Good correlation to service behaviour in a selected environment of adequate severity is of course, essential.

An example of mechanical damage is the impingement of sand and gravel. This may cause local defects ranging from light abrasion, to crazing of the film and even to removal of the oxide coating. Proper selection of the alloy, temper, gauge, shape and design of the part and location during service can greatly reduce this type of surface deterioration. The anodizing conditions (excluding hard anodizing) and the film characteristics, once the thickness is set, appear to be of minor importance.

The light fastness of a colored anodic film depends particularly on the colourant, film thickness, depth of color and dyeing conditions employed. The type and extent of sealing are also important. Attention is again directed to the need for an adequate test for sealing.

The above brief review of factors causing service deterioration of the anodic oxide surface appearance indicates the need to be able to measure the sealing and corrosion resistance of anodic coatings by convenient laboratory tests. A very complete review of tests reported in the literature has been provided by Wood.[1] Results obtained with certain of these tests have been compared by Hooper,[2] Brace,[3] Spooner[4] and Kape.[5] Many accelerated corrosion tests have been proposed and several are included in commercial process or acceptance specifications for anodic coatings. Most of these procedures were developed and are widely used for electroplated coatings on metals other than aluminum. No extensive study is available on the application of such tests, particularly those recently proposed, to anodic coatings on aluminum alloys and it is believed that some of these procedures may be unsuitable.

This paper compares the results obtained in the more common of these laboratory tests with a series of bright trim alloy panels. These were coated with a relatively thin anodic film and sealed for various periods. The object was to determine on a limited basis which test is most appropriate for bright trim applications.

ANODIZING AND SEALING PROCEDURES

In all cases, the material used was Alcan G57S (AA5457) sheet alloy of the following composition:

Cu	Fe	Mg	Mn	Si	Al
0.12	0.09	0.87	0.32	0.07	remainder

This material was mechanically buffed, then chemically brightened in a proprietary solution of the phosphoric-nitric acid type. Following rinses in warm then cold running water, the material was immersed in nitric acid solution (1:1) to remove "smut" and residual phosphates (an essential step). The specimens were anodized for 16 mins. in 15 per cent by wt. sulphuric and acid solution at 21C with a current density of 15 amps per sq. ft. to obtain a nominal anodic film thickness of 0.3 mil (0.0003 in.). After prolonged rinsing in cold running water, the material was sealed in fresh, deionized water at *p*H 6.0 ± 0.2 and 100C for 0, 1, 5 or 15 minutes. These panels were then rinsed, dried and stored in a desiccator. With coatings of this thickness, panels sealed for 1 minute were considered as being practically unsealed, for 5 minutes, partially-sealed and for 15 minutes, well-sealed.

DYE TESTS

The well known ASTM dye or ink test[6] involves the application of a cold dye solution to the surface followed by noting the degree of colour formed and its ease of removal on washing. This is intended to provide a measure of the degree of sealing but the test has been criticized strongly as being inadequate.

In the present work only panels sealed for 0 and 1 minute became coloured and so failed the test, while those sealed for 5 and 15 minutes passed. However, it is known from other work that the panel sealed for 5 minutes develops bloom on exposure in urban atmospheres due to inadequate sealing and so should have been rejected by a suitable sealing test.

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The use of carbon tetrachloride, rather than water, to dissolve the dye stipulated in the test, increased the sensitivity sufficiently to cause rejection of the 5 minute sealed specimen, but the colour was still very weak. Another dyestuff, Aluminum Golden Orange RLW (aqueous solution, 3 g.p.l., *p*H 7.9) was found to be even more sensitive.

RESEALING WEIGHT GAIN TEST

This test[7] measures the completeness of sealing by determining under specified conditions, the weight gain on resealing in water, expressed as a percentage of the anodic film weight. A value of 2 per cent as the maximum acceptable weight gain, although probably too high, was reported[7] in use for one application of this procedure to commercial work.

The following weight gains were observed after twenty minutes resealing:

Original Sealing Time (min)	Resealing Weight Gain (%)
0	9.5
1	9.1
5	2.6
15	1.6

These values show that discrimination in this test between the partially-sealed (5 min) and well-sealed (15 min) material is not particularly high.

ACIDIFIED SODIUM SULPHITE IMMERSION TEST

This sealing test, developed by Kape[8] and studied by the authors,[9] consists simply of immersing the specimen in a solution of sodium sulphite (10 g.p.l. anhydrous salt adjusted to *p*H 3.75 with glacial acetic acid, then to *p*H 2.5 with 5N H_2SO_4) for say a 10 minute period at 85C. The resultant bloom, if any, provides a measure of the inadequacy of sealing. The weight loss also quantitatively indicates the degree of sealing but is less convenient than visual rating of the bloom. Precaution must be exercised to ascertain whether the anodic film has been completely stripped; if so, sealing must have been absent or very poor. Poorly or partially sealed panels develop heavy or light bloom respectively during the test, whereas well sealed work is unaffected. This is shown in Fig. 1A which compares the image clarity and brightness after testing of panels sealed for various periods. The high clarity of the 0 and 1 minute panels as compared to the bloomed, dull appearance of the 5 minute panel is due to the oxide having been stripped during the test. The 15 minute panel has been unaffected and shows the slightly lower image clarity typical of anodized surfaces. The sharp contrast between the 5 and 15 min sealed panels clearly illustrates the usefulness of this test for high discrimination between partially and well sealed material.

SULPHUR DIOXIDE HUMIDITY TEST

Brace[3] has proposed a sealing test for anodic films consisting of exposure in a cabinet to an atmosphere containing sulphur dioxide at a temperature slightly above ambient for a period of 24 hours. The degree of white bloom and deposit formed during the test period decreases as the degree of sealing is raised. This procedure has been considered for inclusion in the British Standard Specification[10] for anodic coatings, which is presently being revised.

The appearance, after this test, of panels sealed for various periods is shown in Fig. 1B. Sealing for 15 min is required to withstand and pass this test. There is a clear visual difference between the partly (5 min) and well sealed (15 min) panels. The long test period makes this test more useful as an acceptance rather than as a shop-process test.

NEUTRAL SALT SPRAY TEST

The salt spray test[11] has been employed for many years as an acceptance test for anodized work. However, it provides only slight discrimination between unsealed and well sealed work (Fig. 1C). Prolonged exposure produces pitting attack with staining as compared to pitting produced in service which has little or no staining. Film thickness affects pitting resistance in this test but thickness is more conveniently, quickly and accurately measured by instruments available than is determination of salt spray resistance.

ACIDIFIED SALT SPRAY

The value of salt spray testing under the more aggressive conditions secured by adding acetic acid[12] has been discussed by McMaster.[13] The major application in his work was for electroplated coatings on steel and zinc base die castings but a brief mention of the use of the test with anodic coatings was included. In our work it has been found that this test serves the dual role of indicating the degree of sealing (by bloom formation during the first 8–24 hr exposure) and pitting resistance. The latter characteristic is greatly improved by increased film thickness, and is affected to a lesser extent by the degree of sealing.

Unsealed or poorly sealed panels (Fig. 1D) developed appreciable bloom and staining while partly sealed specimens showed only a slight amount. The adequately sealed specimen was free of bloom. Work in this laboratory has indicated that well-sealed 0.3 mil anodic oxide films withstand a 24 hour test period with neither blooming nor pitting.

A rise in temperature of the acidified salt spray from 95 to 120F increases the rate but changes the attack to a less desirable type, i.e. stained pits.

COPPER ACIDIFIED SALT SPRAY (CASS)

The great need of the electroplating industry for a laboratory corrosion test to reproduce in a few hours the type of attack typical of industrial environments such as Detroit or Pittsburgh led to the development of the copper acidified salt spray (CASS) and Corrodkote tests. These have contributed greatly to improved plating procedures. The CASS test conditions are aggressive due to the addition of copper salts and to an increase in temperature to 120 from the 95F used in normal and acidified salt spray. Good correlation to service behaviour has been reported with different types of bright nickel/chromium deposits.

The CASS test has been specified for bright trim anodic films[14] probably more because of the current acceptance of this test for plated deposits than because of its particular value to predict the service behaviour of this type of anodic coating. The results obtained with the test (Fig. 1E) have not been favourable in that they do not differentiate between poorly and well sealed materials. As with the neutral salt-spray, the test provides some measure of pitting resistance.

CORRODKOTE

The Corrodkote test[15] differs markedly from the corrosion tests discussed above. A kaolin-water slurry containing metal salts and acid additions is brushed on the surface, dried and then exposed for 20 hours in a humidity (100 per cent) cabinet, followed by removal of the wet powder and examination.

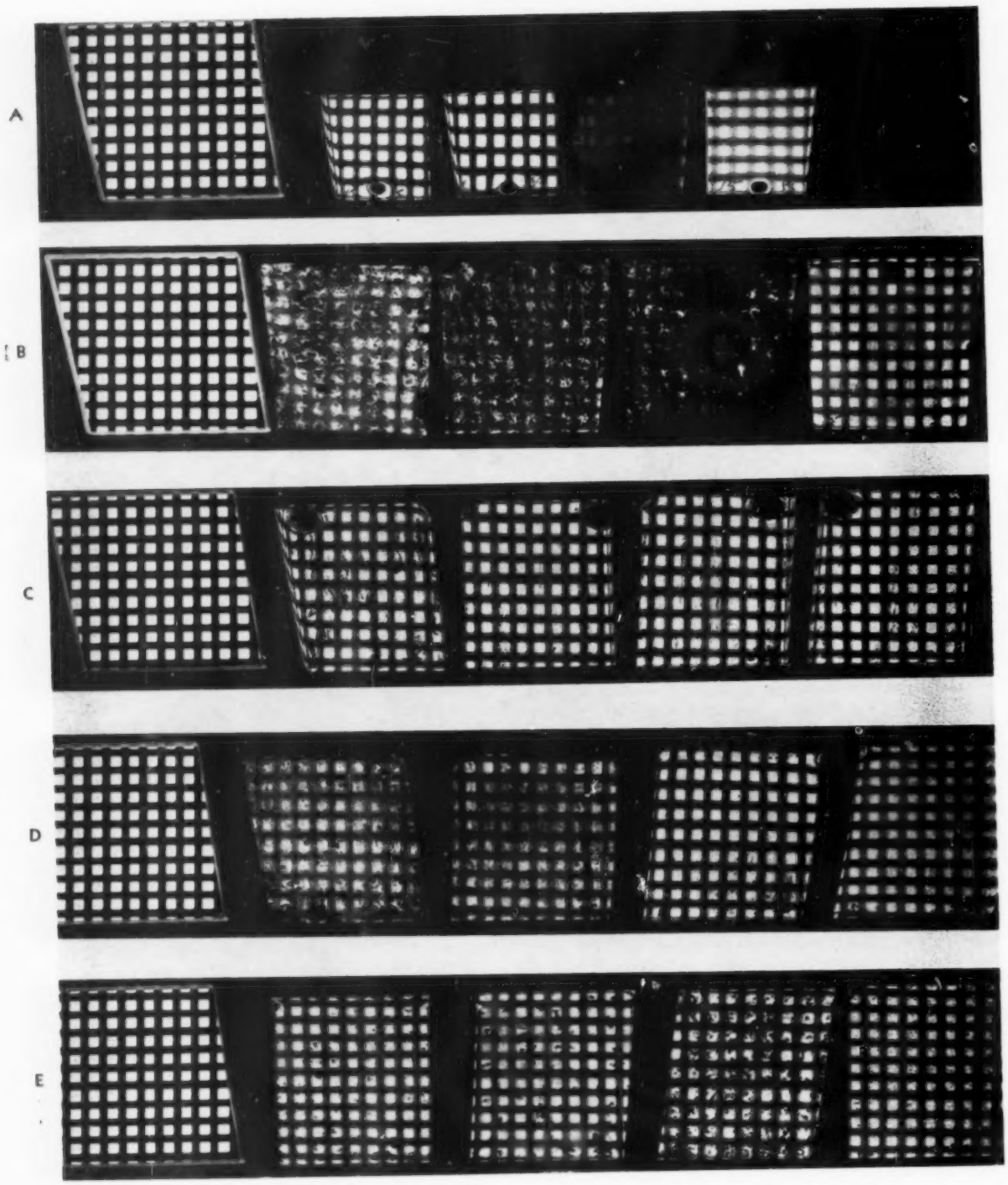

Fig. 1. THE EFFECT OF SEALING TIME IN LABORATORY TESTS OF ANODIZED ALUMINUM

(Glass Mirror at left, then panels sealed in water (pH 6.0, 100C) for 0, 1.5 and 15 min.)

A. Sodium Sulphite
B. Sulphur
C. Salt Spray
D. Acidified Salt
E. CASS test, 6 hours

The extent of the attack after one or more cycles measures the corrosion resistance.

Although this test has not been specified for use with anodic coatings on aluminum it appeared worthwhile to include it in this comparison. A standard 20 hour cycle produced no deterioration in appearance of the anodic film regardless of the degree of sealing. Longer test periods are not convenient in acceptance testing. However, it was noted that by raising the temperature to 111F, one cycle was sufficient to cause deterioration of the anodic film. The type of

pitting varied from fine to coarse with increased degree of sealing. Further study is required of this effect. Other work on this test has shown, as expected, that pitting resistance is raised by increasing the film thickness.

CATHODIC DISSOLUTION TEST

A new interesting type of test has been proposed recently[16] in which a high potential is applied between a platinum anode and the anodized test panel. A drop of the CASS test solution is placed on a small area and the change in potential recorded over a short period to yield a volt-second value. It is claimed that this number varies directly with the corrosion resistance of the anodic coating under test. Values were measured using a voltage recorder and integrating the area under the voltage-time curve obtained during the initial three minute test period. The following results indicate the relative improvement with increased sealing periods.

Sealing Period (Min)	Relative Performance
0	1.0
1	1.06
5	1.12
15	1.18
30	1.18

The results increased slowly but consistently with longer sealing to a maximum (15 min) and remained at this point. The test provides a measure of sealing but is not particularly sensitive to this variable.

SUMMARY

Of the various tests which were investigated, some measure the degree of sealing, others the pitting resistance and one, both these characteristics in differing degree. Among those tests which measure only the degree of sealing, the results show that the acidified sodium sulphite immersion test and the sulphur dioxide humidity test both provide good discrimination, but a slight advantage is apparent in favour of the acidified sodium sulphite immersion test. The resealing weight gain test and the various modifications of the ASTM dye test provide less sensitive measurement of degree of sealing. The dye test and its modifications are the only tests that can be carried out readily in situ.

The tests which measure pitting attack do so by producing a type of attack and an adherent corrosion product differing from that occurring in normal atmospheric exposure. The neutral salt spray and CASS tests are in this category.

The type of test that measures both the degree of sealing and the pitting resistance is most useful. Of the various procedures examined, only the acidified salt spray test falls in this class. It provides an indication of sealing quality and deteriorates the anodic film in a manner similar to that which occurs in service environment. The test period required (24 hours or more) is too long for its use as a quick process control measure, however, it should be considered as an acceptance test for both the degree of sealing and the pitting resistance.

For shop tests during production, instrumental measurement of film thickness and determination of the degree of sealing by the acidified sodium sulphite immersion test should provide good control.

The above results and conclusions indicate the need for further work in this field, particularly to determine the correlation between service behaviour of various types of anodic films and the results of different laboratory sealing and corrosion tests. Very little published work is available in this area. A broad investigation by an industry wide group with a critical evaluation of the results obtained is requuired to provide an accurate basis for specification purposes.

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THE NEED FOR RESEARCH ON ABRADED AND POLISHED SURFACES

by L. E. SAMUELS*

ABSTRACT

A necessary prelude to the solution of many practical problems concerned with the behaviour of abraded and polished metal surfaces is a better understanding of the nature of these surfaces. Attention is drawn to a number of topics which appear to be particularly in need of study.

THE METAL FINISHING INDUSTRY is interested in the behaviour of metal surfaces which have been machined, abraded and polished by various mechanical means. It is interested, for example, in the manner in which the surfaces react in chemical and electrochemical processes, particularly electrodeposition, and in how the surfaces stand up in service. Many investigations have been carried out in the past which have had the object of correlating some such property with variables of surface preparation, but both the planning and interpretation of these experiments has been greatly hampered by a lack of basic knowledge of what the surfaces dealt with are really like and of how they have been altered by the particular finishing processes investigated.

Although this field has been rather neglected in the past, recent endeavours have at least accumulated sufficient information to indicate what the problems are. The purpose of this article will be to point out some of these problems, to highlight some of the things that we don't know and need to know if we are to place our thinking on practical metal finishing problems on a sounder basis.

THE ATOMIC STRUCTURE OF A SURFACE: NUCLEATION OF GROWTH AND DISSOLUTION

The simplest conceivable arrangement of atoms in the outermost surface layer of a crystalline solid is that of a close-packed plane. For this to occur, the surface would have to be atomically flat and exactly parallel to a particular simple crystallographic plane. This situation is approached in special circumstances, such as in the surface of carefully cleaved mica, but real surfaces generally intersect the crystal lattice on a random plane and are anything but atomically flat. Surfaces of the type being discussed have a very complex surface topography indeed and their atomic structure must be correspondingly complex.

A satisfactory atomic model has been developed for an asperity in a surface on the assumption that crystal planes persist without modification right up to the surface.[1] The model indicates that the surface is composed of a series of steps each of which is atomically flat and parallel to some simple crystal plane (Fig. 1); any feature of surface geometry can be accommodated by a suitable arrangement of such steps. Excellent confirmation of this model has been obtained by Müller[2] using his field emission microscope (Fig. 2). These micrographs are obtained from the tip of a very sharp needle and can be interpreted as indicating the positions in plan of individual atoms located at the edges of the atomic steps in the tip (cf. Figs. 1 and 2). In the case of abraded and polished surfaces, account must also be taken of the numerous deformation defects, particularly dislocations, which must emerge at the surface. The field emission micrographs indicate that emergent dislocations can cause atomic steps in the surface just of the type suggested by the standard geometric models of these defects. They may therefore add further complications to the details of the atomic model of industrial surfaces but it should, nevertheless, be quite possible to develop such a model.

The point about all this is that the atoms at the edge, face, and corner positions have different numbers of neighbours and hence have different unsatisfied binding forces. Consequently, some of the positions are preferred sites for nucleation. Remembering that the concentration of any type of site in technical surfaces is probably very high, it is reasonable to ask whether the phenomenon of nucleation, both of growth and dissolution, does not have to be treated in these terms.

Until very recently, the popular approach to this problem was based on considerations of the effects of dislocations emergent at an atomically flat surface, but it is now apparent that this approach is a failure. There is good evidence, for example, that dislocations are not preferred sites for the nucleation of growing oxide films[4, 5] unless, perhaps, they are "decorated" with impurities; again, it is now clear that dislocations are not, unless suitably decorated with impurity atoms, generally preferred sites for the development of etch pits during the dissolution of metals.[6] There is, on the other hand, evidence that steps in a surface are preferred sites for nucleation.[7] In the atomic model of the surface, dislocations are no more than one possible source of atomic steps, and it begins to look as though this is the way in which they should be regarded in this context.

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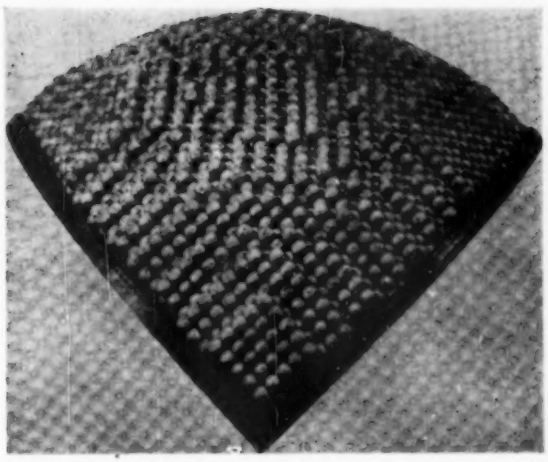

Fig. 1. Ball model of the atomic structure of an asperity in a face-centered cubic crystal. The cube direction is perpendicular to the paper (Wortman, Gomer and Lundy[1]).

If nothing else, this discussion indicates how little is known about nucleation, a subject which is of such fundamental importance to the electrodeposition industry. The problem does not end there, for we also need to know how the nuclei grow laterally and unite, since these factors must also influence the structure and adhesion of the critical first layers of the deposit. The same type of information is required about dissolution, which is the inverse case, because these things determine the details of the topography of etched surfaces. Etched surfaces usually are faceted, the facets tending to expose a simple crystallographic plane. One would like to know what is the mechanism by which these facets develop, what determines the crystal planes exposed, and what determines the size and shape of the facets and hence the true area of the etched surface.

SURFACE OXIDE FILMS

The next way in which real surfaces depart from the ideal is that they are contaminated with adsorbed gas and, with the exception of the noble metals, with films of oxide and other chemical contaminants. It is widely recognized that the presence of the latter films may often have an important influence on the behaviour of the surface, and a good deal of information has been accumulated on the chemical nature of the films, their mean thickness and the relationship between the orientation of the oxide crystals and that of the substrate. The unknown is the physical form of the film.

It is probably true that many think of the oxide film formed during normal exposure to air at room temperature as being reasonably uniform in thickness, although it has also been convenient for the purposes of various theories to assume that the film contains occasional pores and cracks. Surely this picture of the layer is much too simple. It is well established that, at least at an early stage, oxide film formation proceeds by a process of nucleation and growth, the nuclei growing laterally until they touch as well as growing outwards. It is quite possible that the nuclei do not all unite perfectly and very likely that a uniform growth front is not maintained. In addition, further complications arise when the specific volumes of metal and oxide differ appreciably; the existence of this complication is widely recognized but its consequences are still largely speculative.

Some most interesting observations have recently been made on the oxide film formed on a number of metals at elevated temperatures. The growth front has been observed in silhouette by means of the electron microscope,[8, 9] and it has been found in all cases that the outer surface is anything but smooth. A wealth of protruding whiskers, spikes and platelets is characteristic (Fig. 3). The oxide film on industrially abraded and polished surfaces could well be of this form if high surface temperatures are attained (see below). The observations also suggest that there may be some basis for the suspicion that the film formed at ambient temperatures is similarly irregular. But we do not know and we need to know, particularly for purposes such as explanations of corrosion and corrosion inhibition behaviour. Similarly, we need to know if there are pores, cracks and other defect structures present and, if so, what is their form and distribution and how and when they form.

SURFACE PLASTIC DEFORMATION

A reasonable general description of the plastically deformed layer produced by abrasion and polishing is now available.[10] Many details, however, are still lacking. In particular, the general description recognizes that there is an outermost portion of the deformed layer in which the distortions are particularly severe and perhaps of a different type from that of the rest of the deformed layer. This is obviously the portion of the layer that is of the greatest importance in questions which range from fundamental ones such as the detailed atomic structure of the surface to practical ones such as the possibility of whether this layer is a plane of weakness and can contribute to the spalling of electrodeposits. Yet it is the portion of the deformed layer about which least is known.

The reasons are that the layer is difficult to examine experimentally because it is so thin and so severely distorted. Optical metallography has been applied just about to its limit. The layer is rather too thin and too variable in structure to be amenable to X-ray diffraction methods. Electron diffraction techniques are more suitable and a good deal of

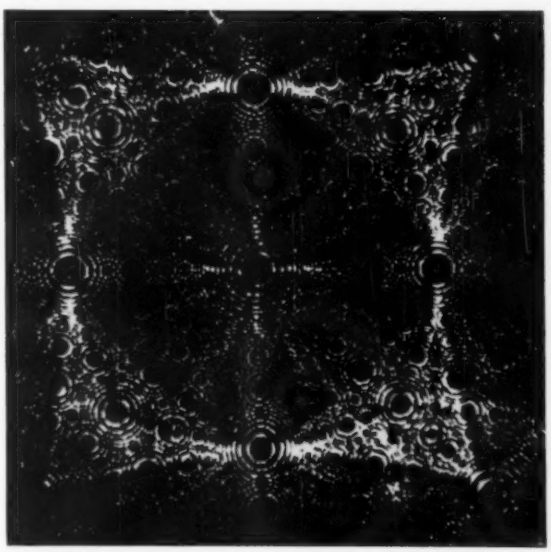

Fig. 2. Field emission micrograph obtained from a sharp asperity in a platinum crystal, platinum being a face-centered cubic metal. The cube direction is perpendicular to the paper. Each spot indicates an atom located at an edge position, such as those at the edges of the steps in the ball model of Fig. 1. (Müller, Pimbley and Mulson[8]).

Fig. 3. Profile of the growth front of the oxide film formed on nickel heated at 800C in dry oxygen. × 8000 approx. (Gulbransen and Copan[9]).

interesting information is being obtained in this way, particularly by the group led by Wilman.[11] However, the technique provides rather indirect evidence on the structure of the surface layers and the average structure of a considerable area at that. More positive information on the local structure, particularly of the dislocation distribution and fine deformation structure, is required. This seems to be a field awaiting the attention of advanced techniques of electron microscopy.

Another basic question is the origin of this specially distorted zone. Although it is apparent that material removal during abrasion and polishing is a metal cutting process, it is equally apparent that the abrasive particles used are far from ideal cutting tools. Their cutting points are of a complex rounded form which is quite variable amongst different types and grades of abrasive, and even within the one grade. Some may be so shaped and aligned as to have a reasonably satisfactory rake angle as a cutting tool, whereas others may have such an unfavourable rake angle that they don't cut a chip at all but merely rub a groove in the surface. Presumably, there is a considerable difference in the surface deformation produced in the two cases.

Therefore, before we can expect to treat the cutting process and its effects more rationally we need to establish the conditions under which these two possible situations can arise. We then need to establish what proportion of the abrasive particles cut and what proportion rub in practical processes, and how this is affected by the manner in which the abrasive particles are mounted and wear in service. We finally need to know whether these things result in important differences in the nature of the deformed layer left in the surface.

SURFACE FLOW

It is widely believed that "surface flow" occurs during abrasion and polishing treatments, particularly polishing treatments. It is not always clear what is meant by this term, but presumably it implies transport of material across the surface from one point to a reasonably remote one.

The idea probably stems from the Beilby concept that polishing occurs by material being smeared across the surface to fill in the pre-existing irregularities. It is now adequately established that this does not happen, certainly not in the abrasion and polishing operations which are being considered.[10] It is conceivable, however, that material may be displaced short distances in a direction parallel to the surface by mechanisms of ordinary plastic deformation. It is certainly observed that the surface grains in machined surfaces are elongated and bent over in the direction of cutting, but even in bad cases the displacement parallel to the surface is considerably less than the depth of cut. This suggests that the phenomenon would be a rather minor one in industrially abraded surfaces, and the limited evidence available suggests that this is indeed so (Fig. 4). It must be admitted, however, that the evidence is neither as conclusive nor as general as could be desired. The problem needs looking at more closely.

There are also indications that there is a rather different plastic deformation phenomenon of greater importance occurring during abrasion. For example, it has been noted that open cavities in the base metal appear to collapse, rather as a balloon deflates, when they move into the surface layer of severest deformation (Fig. 5).[10] There is an obvious need to determine more about this effect, viz: what the forces responsible are, the severity of operation necessary to collapse cavities of different sizes, and the effects of the collapsed cavities on the behaviour of the surface.

The next logical question is what happens to cavities which are filled with a brittle foreign material; for example, to non-metallic inclusions in steels and graphite in cast irons. An answer to this is surely necessary before any explanation can be attempted for the combined effects of non-metallic inclusions and method of surface finishing on the porosity of electrodeposits, a matter that has been the subject of many investigations.

Observations have also been made by Steer,[12] and more recently by Poor et al.,[13] which indicate the presence of fragmented material in industrially finished surfaces. These were all isolated observations, but appear to indicate a phenomenon of importance which needs to be followed up systematically and its cause established.

SURFACE HEATING

One of the most vexatious questions remaining in the field is that of whether high surface temperatures are attained

Fig. 4. Section approximately parallel to the mean surface towards the base of a scratch in a normalized steel abraded dry on a finisher belt. × 2000. The bending of the carbide plates of the pearlite, indicating the extent of the plastic displacement parallel to the surface during abrasion, is even severer here then usual.

Fig. 5. Longitudinal taper section of a ground surface of a bronze casting. × 500. Taper ratio: 10. The feature shown was originally an open shrinkage cavity which collapsed when it entered the surface deformed layer. Displacements of the type illustrated in Fig. 4 could not account for this phenomenon.

during abrasions and polishing. It used to be supposed that the basic mechanism of polishing involved the attainment of sufficiently high temperatures to result in local surface melting. Now that it appears that this is not so, the position has to be re-examined. Appreciable surface temperatures must be attained under some industrial conditions because the whole specimen can become quite hot. The questions are what temperatures and under what conditions.

The meagre experimental evidence at present available is conflicting, ranging from suggestions that quite severe conditions must be exceeded before reasonably high temperatures are attained[14] to suggestions that very high temperatures are attained under the most mild conditions of abrasion.[15] The experimental difficulties are formidable because such a small volume is heated at any one time and because the temperature flash is of such short duration. Attempts to measure the temperature flashes directly have been successful only in cases such as severe machine grinding.[16] The remaining evidence has been obtained by indirect means such as by looking for phases whose presence would indicate that a certain critical temperature had been exceeded. Various attempts have also been made to estimate the maximum surface temperature by theoretical methods,[17] but the assumptions necessary in these treatments are such that they can be used as a guide only. If anything, they favour the view that rather severe conditions are necessary for high temperatures.

Further endeavours aimed at obtaining a clearer solution to this problem are essential, for the matter is one of profound importance. It has already been noted that the temperature attained could have a considerable influence on the form of the surface oxide layer. Probably of more importance, however, is the likely influence of surface heating on the structure of the deformed layer. It might firstly result in strain relief and then recrystallization of the layer. Further, it might in some instances result in phase transformations. Of possible cases, the most important undoubtedly is that of martensite formation in steels; it does not take much imagination to appreciate the practical consequences of such a result. It is well established that this sort of thing can occur under severe grinding conditions; the critical questions are what are the limits to the phenomenon and what are the guiding principles.

REMARKS

No attempt has been made to make this appraisal exhaustive, attention having been confined to those topics which appear to be most in need of attention. The list is nevertheless an impressive one, and is sufficient to indicate that the problems remaining unsolved are numerous and basic. This is perhaps no more than is to be expected from the very limited amount of attention that the field has received in the past. It also serves to support the thesis advanced in the introductory remarks of this paper that satisfactory solutions to many of the practical problems confronting the metal finishing industry cannot be expected until such matters are more fully studied.

ACKNOWLEDGMENTS

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ELECTRODEPOSITION OF IRON-ZINC ALLOYS FROM THE PYROPHOSPHATE BATH

by VASANTA SREE and T. L. RAMA CHAR*

ABSTRACT

Iron has been codeposited with zinc from the pyrophosphate bath. A detailed study has been made of the effect of the variables on alloy composition, cathode efficiency and cathode potential. The optimum conditions for obtaining satisfactory alloy deposits in the composition range 20 to 50 per cent iron are: composition of solution—iron 5.6, zinc 19.6, pyrophosphate 174.0 g/l; pH 9.5, 60C, cathode current density 0.35 to 8.4 amp.dm,^{2} cathode efficiency 42 to 85 per cent. Alloys in the range 10 to 100 per cent iron can be obtained by varying the operating conditions. There were sudden changes in plate composition and cathode potential at low current densities due to the deposition of alloys of different phases as shown by x-ray studies: alpha, alpha plus epsilon, and zeta phases. In the high current density range the composition of the deposit was practically constant.

INTRODUCTION

ALLOYS OF IRON AND ZINC have been deposited from sulphate[1-6] and chloride[4] solutions. Most of the work is, however, covered by patents, and detailed information of an academic character is lacking. It has been shown in this laboratory that the pyrophosphate bath can be used for the plating of iron[7] and zinc.[8] The preliminary work on the codeposition of iron with zinc from this bath has been briefly reported earlier.[9]

EXPERIMENTAL PROCEDURE

Plating solutions were prepared from potassium pyrophosphate, ferric chloride and zinc pyrophosphate. The pyrophosphate content was in excess of that required for complex formation. The molar ratio of pyrophosphate $(P_2O_7)^{-4}$ to metal was 2.5. Only solutions containing a low zinc concentration of 0.025M and 0.05M, and iron concentration of 0.1M, required a ratio of 4 in order to keep them stable. Physico-chemical measurements have shown that the metal ion concentration (g. ion/l) for the pyrophosphate complexes are of the order of 10^{-7} for iron and 10^{-5} for zinc. The ferric iron was estimated by stannous chloride reduction

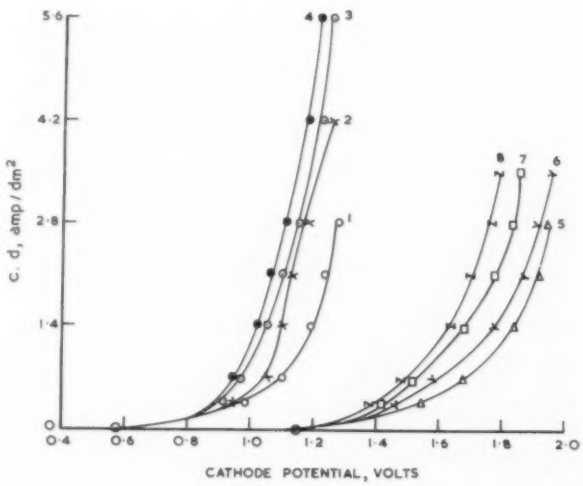

Fig. 1. Cathode potential curves for iron and zinc. Ratio 2.5, temp 60C, pH 9.2–9.9 throughout unless otherwise stated. 1–4 Fe: (1) 0.025, (2) 0.05, (3) 0.1, (4) 0.15M; 5–8 Zn: (5) 0.05, (6) 0.1, (7) 0.2, (8) 0.3M.

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TABLE I
EFFECT OF VARIABLES ON ALLOY DEPOSITION

Variable	Per cent Fe in deposit	Cathode efficiency	Limiting c.d.	Cathode potential
Fig. No.	2–4	5	2–4	6–8
Increase in c.d.	decrease, then constant	general increase	—	increase, with sudden jump
Increase in Fe concn. of soln.	increase	variation irregular	increase	decrease
Increase in Zn concn. of soln.	decrease	increase	increase	increase
Increase in P_2O_7 concn. of soln., ratio 2.1, 2.5 and 3	little change	little change	no change	slight increase
Increase in total metal concn. of soln.—0.1, 0.2, 0.4, 0.53M	little change	variation irregular	increase	slight decrease
Increase in pH of soln.	little change	increase	no change	slight increase
Increase in temperature—40, 50, 60, 70, 80°C	increase at very low c.d, then little change	decrease at very low c.d, then little change	increase	decrease
Addition agents				
Am. fluoride	decrease	decrease	decrease	variation irregular
Rochelle salt	little change	decrease	decrease	little change
Pot. cyanide	little change	decrease	no change	slight decrease
Molybdic acid	increase at very low c.d, then little change	decrease at very low c.d, then little change	no change	little change

and titration with standard potassium dichromate, zinc by titration with standard potassium ferrocyanide, pyrophosphate by the ammonium phosphomolybdate method, and orthophosphate by the method of Kolthoff and Stenger. The deposit was stripped from the cathode with 1:1 hydrochloric acid (sp. gr. 1.17) and analysed.

For each experiment, a 200 ml portion of fresh solution was used. A cylindrical hollow cathode of platinum or copper ($1\frac{1}{2}$ in. length by $\frac{3}{8}$ in. diameter) slipped over a stainless steel rod was placed inside a ring shaped platinum anode such as used for electroanalysis. The inter-electrode distance was $\frac{1}{2}$ in. A zinc anode corrodes satisfactorily but an iron anode, either cast or electrolytic, is totally passive in pyrophosphate solutions. Separate anodes of the two metals were, therefore, not used. The bath was worked under still conditions as agitation did not improve its performance. The plating time varied from 10 to 60 minutes.

The cathode efficiency was determined by the usual method for alloys.[10] A Philips Conductivity Bridge was used for specific resistivity measurements. The pH was measured with a glass electrode, and adjustments were made with hydrochloric acid or potassium hydroxide. Conditions were carefully controlled to obtain electrode potential values (hydrogen scale) to an accuracy of ± 0.005 v. The data have, however, been presented to the second decimal place, the sign of the potential being negative. A decrease in the cathode potential means that the potential is less negative. The rest of the experimental details were the same as described before.[11] The conventional throwing number was calculated from the equation of Gardam[12] for a linear relationship between cathode potential and the logarithm of the current density. Photomicrographs of the surface of a thick coating (0.001 in.) of the deposit were taken with a Leitz Projection Microscope. X-ray powder patterns of the deposit were obtained with a Siemens, Baujahr 1950 Model Unit. Iron K α radiations were utilized at 35 KV and 15 milliamperes, with a manganese filter.

EXPERIMENTAL RESULTS

Figure 1 presents the cathode potential curves for iron and zinc at different concentrations. Zinc is the baser of the two metals, its potential being more negative than that of iron.

Alloy deposition was carried out under different conditions with respect to electrolyte concentration, addition agents, pH and temperature. A detailed study was made of the effect of the variables on plate composition, cathode efficiency and cathode potential. The results are presented in Figs. 2 to 11, and Tables I to III. To avoid overlapping, part of the data obtained are omitted from the figures and tables. The recorded data correspond to good quality deposits. The effect of the variables on alloy deposition are summarized in Table I.

The bath gives adherent and smooth deposits with 10 to 100 per cent iron, the colour ranging from dull grey to bright greyish white with an increase in the iron content. The bath was stable under the experimental conditions. Beyond a temperature of 80C, however, the iron in the solution had a tendency to precipitate. The insoluble anode is quite satisfactory to obtain alloys of any desired composition, but it will be difficult to control the bath composition in view of the gradual depletion of the metal concentration. Ageing up to six months had little effect on the bath performance. The orthophosphate in the solution was practically negligible. Coatings thicker than 0.0005 inch could be obtained. They were resistant to corrosion by the laboratory atmosphere (1 to 2 years) and did not change much in appearance or colour. The total metal content was 99.9 to 100 per cent.

Operating Conditions

Table II gives the operating conditions for obtaining satisfactory deposits together with the plating characteristics under optimum conditions. The bath is satisfactory from the view-point of (a) cathode current density (up to 20 amp/dm² with agitation), (b) cathode efficiency, (c) quality and composition range of deposit, and (d) throwing power of the solution.

TABLE II
OPERATING CONDITIONS

	Range	Optimum
Bath composition, g/l		
Ferric chloride ($FeCl_3.6H_2O$)	6.8–40.5	27.0
Zinc pyrophosphate	4.7–75.2	56.4
Pyrophosphate $(P_2O_7)^{-4}$	43.5–231.4 (0.25–1.33M)	174.0 (1.0M)
Iron	1.4–8.4 (0.025–0.15M)	5.6 (0.1M)
Zinc	1.6–26.2 (0.025–0.4M)	19.6 (0.3M)
pH	8.2–10.2	9.5
Temperature, °C	40–80	60
Sp. resistance, ohm cm/cm²	4.40–7.57	4.81
Bath voltage, v	2.5–3.8	2.5–3.6
Agitation, rpm	0,800	Nil
Cathode c.d, amp/dm²	0.35–8.4 5.6–20.0, agitation	0.35–8.4
Cathode efficiency, per cent	10–87	42–85
Cathode potential, v	0.88–1.81	0.99–1.35
Throwing number, N	—	0.1733
Deposit		
Composition, per cent Fe	10–100	20–50
Time to deposit 0.0005 in., (mins. at 4.2 amp/dm².)	—	16

DISCUSSION

The experimental results show that the pyrophosphate bath is suitable for the plating of iron-zinc alloys. The total metal concentration in the iron-zinc pyrophosphate bath is comparable to that in the acid baths. The current density is, however, higher in the latter case.

Alloy Composition

The iron content of the deposit could be increased chiefly by an increase in the iron or decrease in the zinc concentration of the solution, decrease in current density, and to some extent by an increase in the temperature (Figs. 2 to 4). The other variables had no significant effect on the alloy composition, the maximum variation being 7 per cent iron. The effect of current density was significant only at low values; in the high current density range the composition was practically constant. Sudden jumps occurred in both composition and cathode potential in the lower current density range. A similar observation has been made by Foerster.[5] He did not find any significant effect of temperature on composition. Jepson and coworkers[3] as well as Tripathi and Udupa[6] have, however, found that the zinc content in the deposit decreases with increase in current density. Work done in this laboratory has shown a similar constancy of composition during the deposition of alloys of nickel with cobalt,[13] tin,[14] iron[15] and zinc,[16] and of tungsten with nickel[17] or cobalt[18] from pyrophosphate solutions.

In the deposition of iron and zinc, the free pyrophosphate content of the solution had little effect on the plating characteristics. The observed behaviour in alloy deposition is to be attributed to the presence of the same complexing anion for both metals and the excess of free pyrophosphate in the bath. Addition of 5 g/l ammonium fluoride to the bath decreased the iron content of the deposit (from 25 to 8 per cent at 2.1 amp/dm²), and 1 g/l molybdic acid increased the iron content at low current densities (from 34 to 89 per cent at 0.7 amp/dm²).

In acid baths for iron-zinc alloy plating the ratio of iron

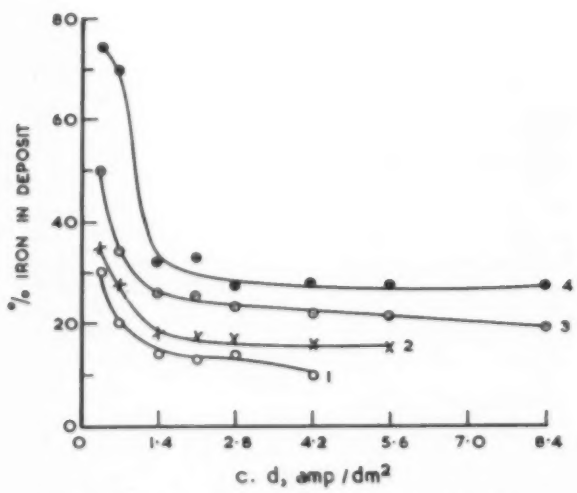

Fig. 2. Effect of iron concentration in solution on deposit composition. Zn 0.3M, Fe: (1) 0.025, (2) 0.05, (3) 0.1, (4) 0.15M.

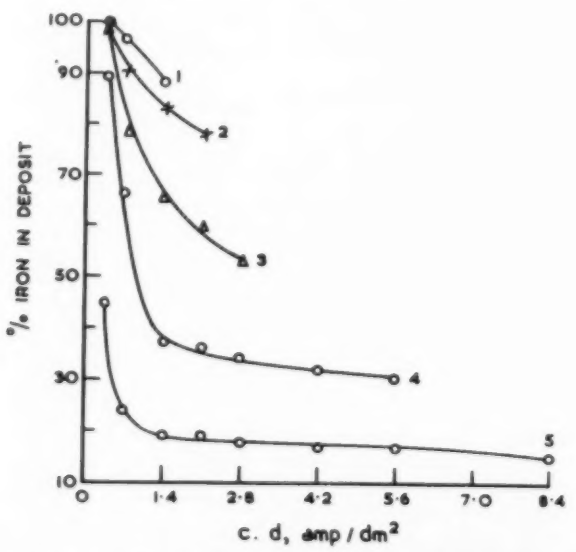

Fig. 3. Effect of zinc concentration in solution on deposit composition. Fe 0.1M, Zn: (1) 0.025, (2) 0.05, (3) 0.1, (4) 0.2, (5) 0.4M.

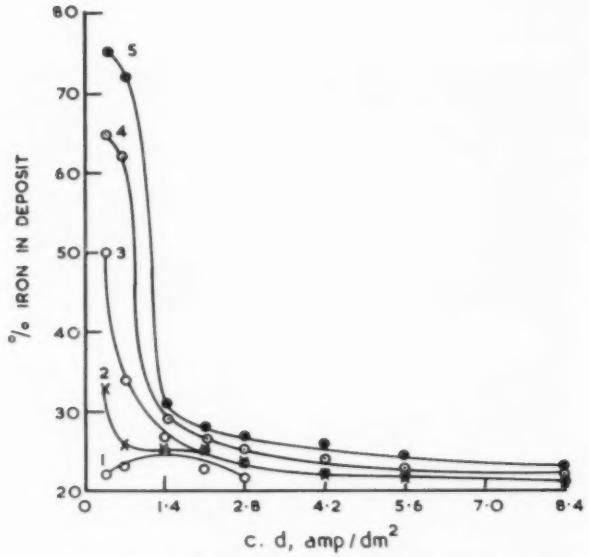

Fig. 4. Effect of temperature on deposit composition. Fe 0.1M, Zn 0.3M, pH 9.5, Temp °C: (1) 40, (2) 50, (3) 60, (4) 70, (5) 80.

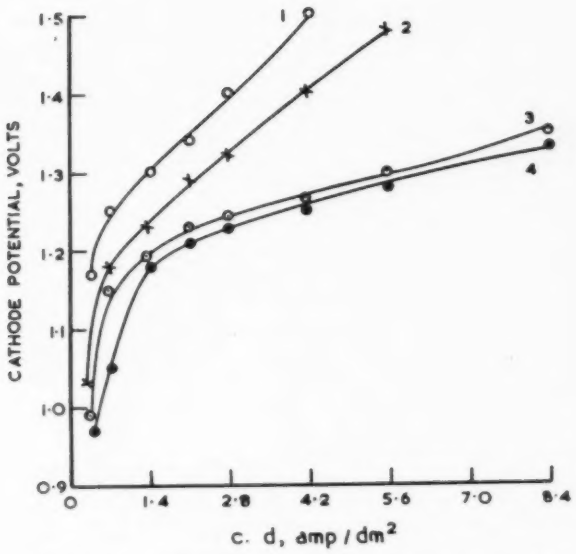

Fig. 6. Effect of iron concentration in solution on cathode potential. Conditions same as in Fig. 2.

to zinc in the solution is greater than that in the deposit.[4, 5] Foerster[5] attributes this to the retardation of iron deposition. Jepson and coworkers[3] have reported that the metal ratio in the bath is proportional to that in the deposit. The present investigations, however, show that there is no direct relation between the metal ratio in the solution and that in the deposit. It is possible to work the bath with a wide range in the ratio of iron to zinc and obtain alloys of any desired composition. Low current densities have to be used in order to deposit alloys with a high iron content.

Cathode Efficiency

The cathode efficiencies with which pure iron is deposited from an iron pyrophosphate solution and zinc from a zinc pyrophosphate solution, are, respectively 7 to 66 and 43 to 80 per cent, if the baths are operated over the same range of conditions as the alloy baths used in this study. The alloy efficiency is 10 to 87 per cent, generally closer to that of zinc (Fig. 5). Foerster[5] has obtained efficiency values in the range 65 to 95, and Tripathi and Udupa[6] report values of the order of 68 to 87 per cent, there being a lowering with agita-

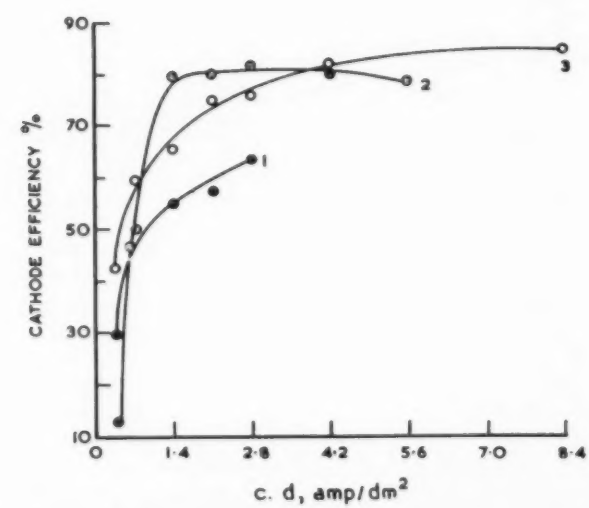

Fig. 5. Effect of iron and zinc concentration in solution on cathode efficiency. Electrolyte: (1) Fe 0.1, Zn 0.1; (2) Fe 0.05, Zn 0.3; (3) Fe 0.1, Zn 0.3M.

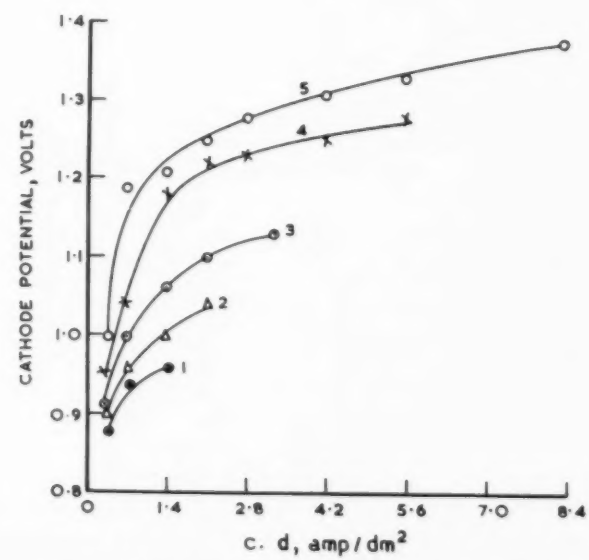

Fig. 7. Effect of zinc concentration in solution on cathode potential. Conditions same as in Fig. 3.

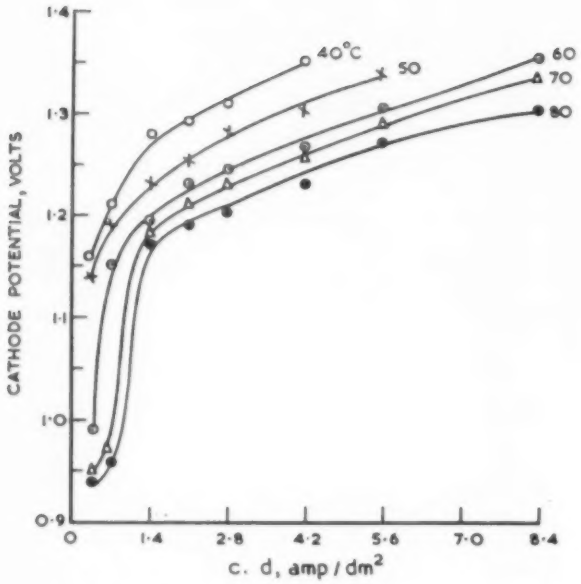

Fig. 8. Effect of temperature on cathode potential. Conditions same as in Fig. 4.

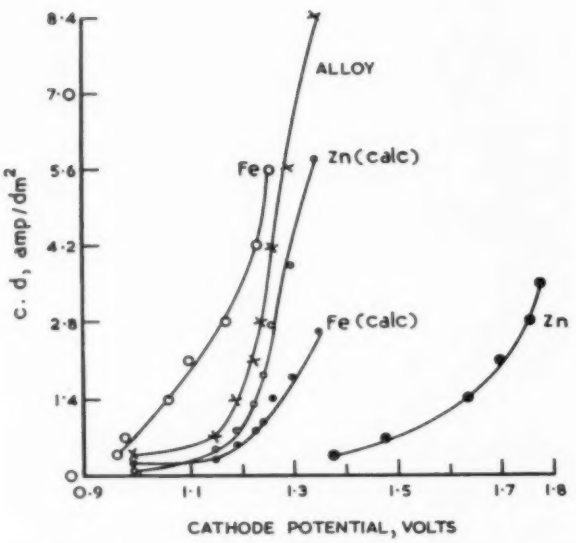

Fig. 10. Reconstruction of single metal potential curves from alloy composition and potential: Bath composition: Fe—0.1, Zn—0.3, Alloy—Fe 0.1, Zn 0.3M.

tion. The effect of current density and zinc concentration in solution can be explained on the basis of an increase in the zinc content of the deposit, zinc depositing at a higher efficiency.[5] The decrease in the efficiency with increase in temperature is due to a lowering in the zinc percentage of the alloy. Increase in the pH of the solution increases the efficiency for iron and also for the alloy. The other variables had no marked effect, the maximum change being 9 per cent. The low alloy efficiency appears to be chiefly due to the low efficiency for iron deposition, and also a possible retardation of the discharge of the zinc ion by iron. Increase in the metal concentration of the solution and temperature increased the limiting current density. Agitation of the solution increased the current density range from 0.35–8.4 to 5.6–20 amp/dm,² the efficiency being 31 to 60 per cent. There was no deposit on the cathode below 5.6 amp/dm² with agitation. Under optimum conditions, the limiting current density values for iron, zinc and the alloy are 5.6, 3.5 and 8.4 amp/dm² respectively.

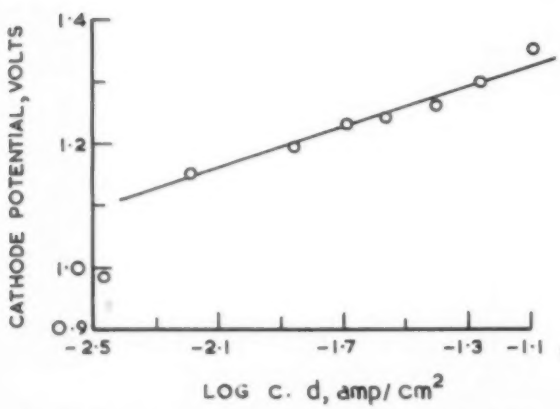

Fig. 9. Cathode potential—Log. c.d. line. Fe 0.1M, Zn 0.3M, pH 9.5.

Cathode Potential

The cathode potential during alloy deposition decreased with decrease in current density, increase in the iron or decrease in the zinc concentration of the solution, and increase in temperature (Figs. 6 to 9). The effect of the other variables was not significant, the variations being not more than 0.06 v. The plating solutions possessed good throwing power as observed visually. The deposition potentials for iron, zinc and iron-zinc alloy in pyrophosphate solutions under optimum conditions are 0.64, 1.02 and 0.68 v respectively. An alloy deposit with a high iron content is to be expected at low current densities, as is borne out by the experimental results. Glasstone[19] has obtained deposition potentials for the alloy in the range 0.73 to 0.77 v at various concentrations of sulphate solutions at 55C. The values in pyrophosphate solutions are about the same order.

The sudden changes in plate composition and cathode potential corresponded more or less to the deposition of alloys of different phases from high iron to high zinc, namely, alpha, alpha plus epsilon and zeta. For a small change of 0.35 or 0.70 amp/dm,² the composition changes were quite sharp, the maximum difference in the composition being 50 and 62 per cent iron respectively. The corresponding cathode potentials also varied to an appreciable extent, the difference being of the order of 0.19 and 0.28 v. The current density at which the potential changes occurred depended on the experimental conditions. Foerster[5] has reported potential

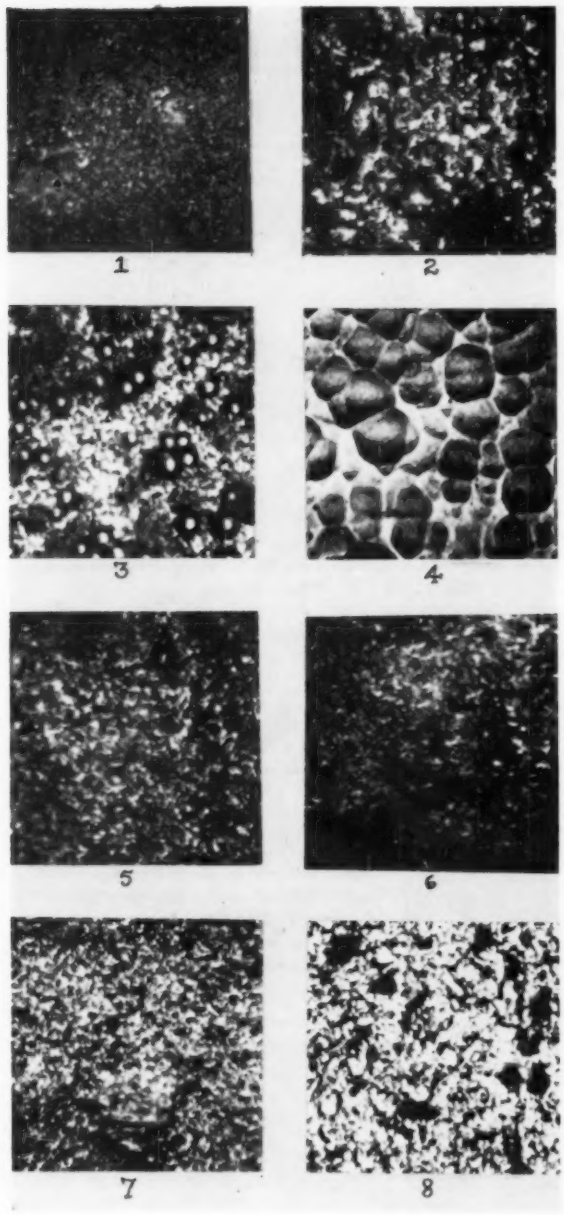

Fig. 11. Photomicrographs of deposits. Copper base, original magnification × 700. Plate 1, Fe only—Fe 0.1M, 2.1 amp/dm²; Plate 2, 98 per cent Fe—Fe 0.1M, Zn 0.025M, 1.4 amp/dm²; Plate 3, 86 per cent Fe—Fe 0.1M, Zn 0.05M, 2.1 amp/dm²; Plate 4, 55 per cent Fe—Fe 0.1M, Zn 0.1M, 2.8 amp/dm²; Plate 5, 31 per cent Fe—Fe 0.1M, Zn 0.2M, 2.8 amp/dm²; Plate 6, 23 per cent Fe—Fe 0.1M, Zn 0.3M, 2.1 amp/dm²; Plate 7, 16 per cent Fe—Fe 0.025M, Zn 0.3M, 3.5 amp/dm²; Plate 8, Zn only—Zn 0.3M, 1.4 amp/dm².

jumps of about 0.24 v, the same order as in the present work, at 2.2 amp/dm.² corresponding to a change of 58 per cent iron in the deposit. Foerster[5] and Glasstone[19] have explained that the jump in potential occurs simultaneously with a decrease in the iron ion concentration in the vicinity of the cathode, so that a zinc-rich alloy with a high hydrogen overvoltage is deposited. In the high current density region where the plate composition was practically constant, the potential changes were comparatively very small, about 0.16 v, for a current density rise as high as 7 amp/dm.² In this region the potential values are very close to those of zinc, and a high-zinc deposit of more or less constant composition is obtained. Similar changes in plate composition and cathode potential have been observed during the deposition of alloys of different phases in tin-copper[20] and nickel-zinc[16] from the pyrophosphate bath.

The cathode potential curves (Fig. 1) for iron and zinc are far apart. Nevertheless, alloy deposition is possible because of the mutual influence of the two metals. From the alloy potential and composition it is possible to determine the proportion of the current that is used in the deposition of each metal and to plot corresponding potentials for each. Calculations of this nature, wherever possible, will give a fairly quantitative picture of the extent of influence of one metal on the other during alloy plating. Studies of this type have been made in this laboratory for the deposition of alloys of nickel with copper,[21] zinc[16] and cobalt,[13] and brass[11] from the pyrophosphate bath. Figure 10 presents the cathode potential curves of the iron-zinc system under optimum conditions: alloy potential, single metal potentials—observed and calculated. The alloy curve is closer to the experimental iron curve than the experimental zinc curve. When the curves are reconstructed, the zinc curve is closer to that of the alloy, indicating that a low-iron deposit is to be expected at higher current densities. The extent of depolarization of zinc is much more than the polarization of iron, and the reconstructed curves are very close. It is also seen that above a certain current density, both the alloy and the reconstructed single metal curves tend to straighten out. Under these conditions the alloy deposit is expected to have a constant composition. The results support these expectations. Calculations for solutions containing iron 0.1M and zinc 0.2M, and iron 0.15M and zinc 0.3M gave similar results.

Structure of Deposits

The photomicrographs in Fig. 11 show that the zinc-rich alloys are finer-grained than zinc. X-ray studies of the deposits broadly showed the existence of alpha, alpha plus epsilon and zeta phases (Table III). However, the epsilon phase which has a very narrow composition limit, was missing. It was not possible to deposit alloys with a very low iron content suitable for x-ray examination. The lattice values for the epsilon phase have not been given in view of the complicated cubic structure. The compositions corresponding to the phase boundaries for the electrodeposited alloys are somewhat different than those for alloys prepared thermally. Detailed studies are needed in order to obtain a clear picture of the structure of these electrodeposited alloys.

TABLE III

X-RAY STUDIES

Conditions as in Fig. 11

Plate No.	Per cent Fe	Phase	Lattice	Experimental Å a	Experimental Å c	Reported Å a	Reported Å c
1.	Iron only		b.c.c.	2.857		2.861	
2.	98	α	b.c.c.	2.886			
3.	86	α	b.c.c.	2.869			
4.	55	$\alpha + \epsilon$	b.c.c.	2.844			
			+ cubic	—			
5.	31	$\alpha + \epsilon$	b.c.c.	2.980			
			+ cubic	—			
6.	23	ζ	c.p.h.	2.702	4.377		
7.	16	ζ	c.p.h.	2.758	4.413		
8.	Zinc only		c.p.h.	2.657	4.915	2.659	4.936

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THE RESISTANCE TO OXIDATION OF NICKEL-CHROMIUM ELECTRODEPOSITS ON MOLYBDENUM

by C. WILLIAMS* and R. A. F. HAMMOND*

ABSTRACT

Methods of electrodepositing nickel and chromium on cylindrical test-pieces of 0.5 per cent Ti molybdenum alloy are described and the results of oxidation tests at 1100C (2012F) of various combinations and thicknesses of multilayer coatings of nickel and chromium are presented. Oxidation lives of 5 mil coatings typically range from 300–500 hr under conditions of limited daily cycling from 1100C to ambient temperature.

Measures to increase the chromium content of the outer zone of the diffused coatings were found to be effective in increasing the life and also appeared to improve the reproducibility.

A four-fold increase in life to 1200 hr was achieved by applying a 3 mil top-coat of sprayed alumina.

The modes of failure of the coatings are described and discussed.

INTRODUCTION

THE ATTEMPT TO ACHIEVE greater thermal efficiency in gas turbines and aircraft jet engines has resulted in recent years in a demand for even higher operating temperatures and this, in turn, has led to intensified effort to develop materials of construction which retain their strength and do not oxidise unduly at these high temperatures. Molybdenum is potentially valuable for these applications and Begley[1] has shown that, at any stress level, this metal is at least 350F (180C) superior to the best conventional heat-resisting alloy. However molybdenum oxidises rapidly at quite low temperatures (above ca 1000F or 540C) owing to the volatility of the oxide MoO_3 and, at about 1400F (770C), the rate of evaporation of the oxide equals its rate of formation. Furthermore molybdenum trioxide melts at 1465F (795C) and, at slightly higher temperatures, the rate of oxidation accelerates catastrophically.

It is evident therefore that the feasibility of using the present molybdenum alloys for such components depends entirely upon the successful development of a coating which, under the conditions of service, will protect the molybdenum from oxidation for a period of time. This, according to the particular application, may range from a few hours to several hundred hours.

Harwood[2] has summarised the basic requirements of such a coating for the gas turbine application and these include resistance to oxidation, thermal shock, impact, erosion, and fatigue. In addition he suggests that the coating must be capable of application below the recrystallisation temperature of the molybdenum, should preferably be ductile and should not interact with the base alloy so as to impart brittleness and it should be suitable for application to complex shapes.

Of the many types of protective coatings which are being investigated for this purpose (ceramic, vapour-phase, sprayed, clad etc.), electrodeposition offers the advantages that it is a cold process and requires only techniques and facilities which, broadly speaking, are generally available and well-established industrially. Considerable effort has therefore been devoted to solving the electrodeposition approach to this problem, especially in the U. S. A., and there is already a fairly extensive literature on this subject.[3–10] The broad conclusion from all these investigations is that, despite variability of performance (especially in the earlier work) and some unsolved problems, the behaviour of nickel and chromium coatings in various combinations has been sufficiently promising to justify further investigation.

The present paper describes the results of the first phase only of an investigation now in progress in this Establishment viz. the development of a preferred coating, its evaluation by oxidation tests involving only limited thermal cycling, a preliminary study of the mode of failure and the use of sprayed alumina as a top-coat.

Work currently in hand includes severe thermal shock tests on flat specimens, trials of various undercoats and top-coats and the plating of components for user evaluation.

EXPERIMENTAL

1. Test-pieces

These were cylindrical in form, 2 inches long and 0.25 inch diameter, hemispherical at one end and welded to a mild steel

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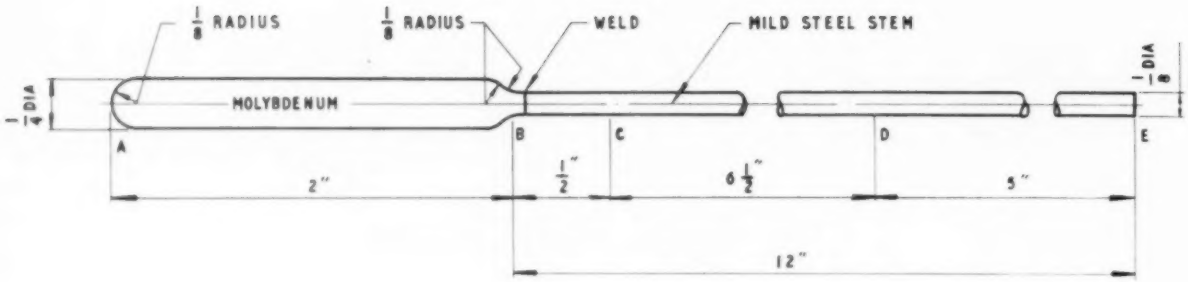


Fig. 1. Construction of test piece.

wire $\frac{1}{8}$ inch diameter and 12 inches long at the other (Fig. 1). The material was arc-melted 0.5 per cent titanium alloy, swaged down to rod form and finished by turning. The welded end was machined to provide a smooth blended contour with the steel rod. The rod served to provide a contact for the electroplating operations and also a method of suspending the specimens freely in the furnace thus avoiding spurious effects arising, either from contact of the specimens with one another, or with a refractory support. Mild steel was used for the rod as preliminary trials with rods of oxidation-resistant metals showed that adhesion of chromium to the rod and to the molybdenum using a common cleaning procedure could not be achieved with these alloys. It was therefore necessary to protect the mild steel rod against oxidation in the furnace. This was done by plating the specimen and the rod separately allowing an overlap of approximately half an inch at the specimen end (Fig. 1-BC). The length A to C was plated first, the rod being stopped-off with wax from C to D. The wax was then removed, the specimen A to B stopped-off and the section B to D plated with 3 to 4 mil chromium followed by 12 mil nickel.

The cylindrical form of test-piece, which admittedly represents an easy condition both in plating and in subsequent thermal testing, was deliberately chosen for this stage of the work to avoid the preliminary assessment of the various test-coatings being obscured by sporadic failures arising from edge-effects or laminations in rolled sheet material.

TABLE I

COMPOSITION OF PLATING SOLUTIONS AND OPERATING CONDITIONS

Composition		Operating Conditions: temp °C	C.D.-A/ft²
Chromium			
Chromium trioxide, CrO_3	250 g/l	50	200
Sulphuric acid H_2SO_4	2.5 g/l		
Nickel 'strike'			
Nickel Sulphate, $NiSO_4.7H_2O$	240 g/l	40	180
Sulphuric acid, H_2SO_4	50 g/l		
Nickel (operated at pH 4.0)			
Nickel sulphamate, $Ni(NH_2.SO_2.O)_2$	350 g/l	50	40
Nickel chloride, $NiCl_2.6H_2O$	3.3 g/l		
Boric acid, H_3BO_3	30 g/l		
Sodium lauryl sulphate	0.1 g/l		

2. Plating Methods

For nickel and chromium plating a sulphamate solution and the standard hard chromium (HC) solution respectively were used, with a nickel 'strike' interposed between chromium and nickel deposition. The composition of the solutions and the conditions of operation are in Table I.

The sulphamate nickel solution was adopted in preference to the Watts bath to secure a higher rate of deposition and on account of the reported higher thermal stability of this type of nickel.[5]

In accordance with the usual practice for obtaining high adhesion of the electrodeposits to molybdenum, chromium was always plated first followed by nickel and, in the case of multilayer coatings, by further deposits of chromium and nickel alternately. These platings were tried in various thicknesses and combinations as described below.

It is clearly essential to attain high adhesion of the coatings one to another and to the molybdenum substrate. After a few early failures no difficulty was encountered on this score. The cleaning and plating sequence which is scheduled in detail in the Appendix consisted of the following main stages* in which procedures relating to the plating of the steel supporting rod are omitted.

1. Vapour degrease
2. Alkali degrease (cathodic)
3. Anodic polish in conc. H_2SO_4/H_3PO_4 (1:1) v/v
4. Dip in 50 per cent NaOH, 2 min, room temp.
5. Reverse etch in chromium solution, 1 min.
6. Chromium plate
7. Nickel strike
8. Nickel plate (for multilayer coatings repeat stages 6–8)

* Rinses where appropriate (not shown).

3. Oxidation testing.

Oxidation tests were carried out at 1100C (2012F) using an electrically heated vertical tube furnace in which the specimens were suspended freely in the middle of the hot zone. The furnace was fitted with a temperature controller-recorder and the temperature was maintained constant to within ± 10C (± 18F). A low velocity air stream was allowed to circulate through the furnace and there was provision for automatic switching-off of the furnace by means of a photo-electric cell when MoO_3 was emitted on failure of a specimen.

The test pieces were removed from the furnnce for a short period each working day to permit visual examination of the coating. Apart from this brief period of cooling (which also provided limited thermal cycling) the specimens were maintained continuously at temperature until failure occurred. The criterion of failure was taken as the first indication of molybdenum trioxide on the surface of the specimen or the visible evolution of MoO_3.

4. Coating variants

The various coatings investigated are briefly listed in Table II. As in the case of most of the earlier investigations, the proportions of nickel and chromium were such as would give (assuming complete diffusion) a nickel-chromium alloy of 80:20 composition.

The first trials were made with duplex coatings 5 mil thick

TABLE II

OXIDATION TESTS: LIVES OF VARIOUS ELECTRODEPOSITED COATINGS AT 1100C IN AIR

	Coating			Life at 1100C, hours			
	Main‡	Top-coat or Surface Treatment	Nominal thickness of main coating, in.	Individual tests	Max.	Min.	Mean*
A	0.001 in. Cr + 0.004 in. Ni	—	0.005	168, 180, *24*, 258	258	*24*	200
B	Alternate layers of 0.0002 in. Cr and 0.0008 in. Ni (nickel outermost)	—	0.005	166, *117*, 298 204, 319, 337, 236, 237, *582*	*582*	*117*	260
C	As B above and diffused in H_2 at 1100C for 4 hours	—	0.005	311, 311, *142* 228, 300	311	*142*	290
D	As B and slowly heated (5 hours) in vacuum to 1100C	—	0.005	215	—	—	—
E	As B above but double the thickness	—	0.010	*130*, 253, 406, 507, 328	507	*130*	370
F	Alternate layers of 0.0002 in. Cr and 0.0008 in. Ni (total 0.003 in.) followed by alternate layers of 0.0001 in. Cr and 0.0004 in. Ni	—	0.005	308, 338, 308	338	308	320
G	As B above but with top-coat of chromium	0.0002 in. Cr	0.005	573, 523, 576, 504, 523, 361, 460, 336, 284, 360, 437, 318, 286	576	284	425
H	As B above but with an under-coat of 0.0015 in. Au	—	0.005	24,† 24†	—	—	—
J	As B above	Cerium nitrate	0.005	264, 264, 280	280	264	270
K	As B above	0.003 in. sprayed alumina	0.005	1206,** 1146,** 1290, *785*	1290	*785*	1200

‡ Coatings tested "as plated" unless otherwise stated.
* Ignoring sporadic high or low results (values in italics).
† Life at 1000C (1832F).
** After the times stated under the standard conditions these specimens were thermo-cycled at frequent intervals and failed after a further 7 and 18 cycles respectively.
NOTE—0.001 in. = 1 mil.

consisting of chromium (1 mil) + nickel (4 mil) – Series A. These were followed by trials of multilayer coatings of the same total thickness terminating with a nickel layer. The thickness of the individual layers of chromium and nickel were 0.2 and 0.8 mil respectively. (Series B.)

Conflicting statements had appeared in the literature concerning the value or otherwise of a diffusion treatment prior to oxidation testing. This point was therefore investigated by tests in which similar coatings to Series B were pre-diffused at 1100C (2012F) for 4-5 hours in hydrogen or in vacuo respectively (Series C and D). The effect of doubling the thickness of the standard multilayer coating was then tried (Series E).

The work of Zima[11] had shown that alloys of nickel and chromium containing 8 per cent of chromium oxidise very much more rapidly than alloys containing either more or less than this concentration of chromium. It was clearly desirable therefore to exceed this critical concentration of chromium near the surface as early as possible in the life of the coating. Two series of experiments (Series F and G) were therefore carried out with the object of achieving this end. In the first, the final two fifths of the 5 mil coating was made up of layers of chromium and nickel 0.1 and 0.4 mil thick respectively (i.e. half the normal thickness) and, in the second, a final coating of 0.2 mil chromium was applied to the standard 5 mil multilayer deposit. Miscellaneous trials included the use of a gold undercoat as a diffusion barrier or a final surface treatment with cerium nitrate. Safranek and Schaer[5] had suggested the potential value of a gold undercoat for preventing outward diffusion of the molybdenum. Two specimens were therefore prepared in which a gold coating 1.5 mil thick was interposed between the first chromium deposit (ca 0.1 mil) and the remainder of the standard 5 mil multilayer coating (Series H). A gold plating solution of the conventional cyanide-tartrate type was used, the specimen being first plated for 1 min at 75 A/ft² in a cyanide 'strike' solution.

A dip in cerium nitrate solution has been shown by Betteridge[12] to increase considerably the oxidation and thermal shock resistance of metallurgically produced 'nichrome' type alloys and this process is commercially applied in the manufacture of electric heating elements. Three Series B type multilayer coatings 5 mil thick were dipped in a saturated solution of cerium nitrate in alcohol and dried prior to oxidating testing (Series J).

While it was appreciated that the rate of oxidation per se of a diffused nickel-chromium alloy deposit was not the limiting factor in the life of the coating, it was considered that a refractory top-coat might prove beneficial by restricting the supply of oxygen and by serving as a heat barrier thus reducing thermal shock to the main coating during heating and cooling.

Four type B deposits, 5 mil thick, were accordingly sprayed with alumina by the Rokide[13] process to a thickness of approximately 3 mil and subjected to the standard oxidation test (Series K).

RESULTS

1. Oxidation tests

The results of the oxidation tests are given in Table II. They are expressed as hours at 1100C to failure or to incipient failure. The results of all the individual tests are shown in the penultimate column. As found by previous workers they varied fairly widely and, in the last column, maximum, minimum and mean lives are shown. In the calculation of the mean lives, sporadic high or low results were excluded. While it is appreciated that the total number of tests was small and that, for the practical requirement, the importance of premature failures cannot be overestimated, the mean figures do provide a broad basis upon which the performance of the different coatings can be compared. The following general indications emerged from these tests:

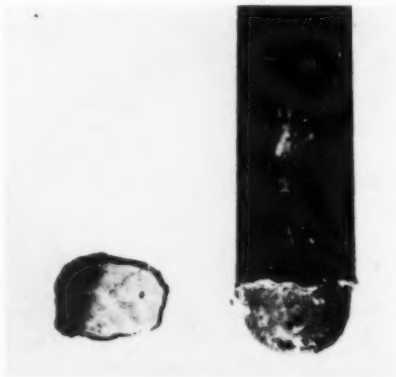
×2.

Fig. 2. Local penetration failure.

(1) For equivalent thickness (5 mil), the multilayer coating with nickel outermost appears to be slightly superior to the duplex coating (Series A). The difference in mean life is not large but, taking the results of Series B, C and J together, an increase of 30 to 45 per cent is indicated. The reproducibility of the multilayer coating also appears to be better.

(2) Pre-diffusion of the multilayer coatings had no significant effect on their oxidation lives.

(3) Doubling the thickness of the multilayer coating (Series E) did not prevent a sporadic low result and, comparing averages, gave only a comparatively minor increase in life (approximately 30 per cent). Examples of sporadic long lives (582 and 507 hr) occurred at both thicknesses.



×3

Fig. 3. Detachment failure.

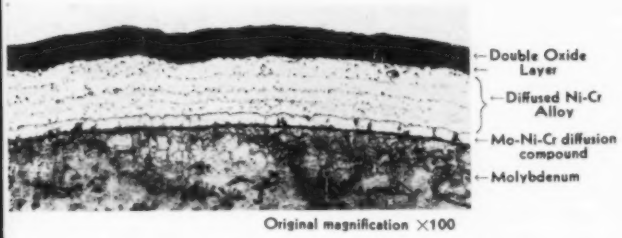


Fig. 4. 5 mil multilayer Ni-Cr coating (nickel outermost) after oxidation for 236 hours at 1100C (un-etched).

(4) The methods adopted to secure a higher concentration of chromium near the surface of multilayer coatings (Series F and G) materially increased the life of the coating, particularly the second method (chromium top-coat).

The results in Table II (F and G) are given in the sequence in which the experiments were performed and it will be noted that, until midway in Series G, the lives obtained were remarkably consistent. The reason for the subsequent deterioration is not understood. However no really short lives were obtained, the minimum approaching 300 hr.

(5) Gold plating to provide a molybdenum diffusion barrier for nickel-chromium coatings does not appear to be feasible even for service at 1000C (1832F).

(6) In spite of the porous nature of the Rokide sprayed alumina coating, its use as a top coat to the 5 mil multilayer coating increased the life nearly fourfold in the standard test.

2. Metallurgical examination and mode of failure

Visual inspection of specimens at room temperature revealed two distinct modes of failure (a) local penetration of the coating at one or more points along the length of the specimen or (b) detachment of the coating at the hemispherical end. Figs. 2 and 3 illustrate the typical appearance of each type of failure.

A number of specimens were sectioned for microscopical examination at the stage of incipient failure, or after failure, and the following general features were observed:

(i) The external coating of oxide consisted of two phases which, though not clearly visible in the photomicrographs, were well defined under the microscope. Except in the immediate vicinity of local failures, at least three to four fifths of the 5 mil diffused nickel-chromium alloy remained sound and unoxidised after testing for 300–500 hours at 1100C (2012F). It is evident therefore that the inherent oxidation resistance of the 80:20 alloy is not the limiting factor in the life of the coating (Figs. 4 and 5).

(ii) Diffusion within the multilayer coating during oxidation testing produced, apart from parallel stringers (Fig. 4) still visible at the locations of the original chromium layers, a single phase alloy of nickel-chromium which appeared to be largely homogeneous. That the coating was not in fact homogeneous was shown by micro-hardness tests,* which revealed a progressive drop in hardness as distance from the molybdenum base increased (Fig. 6). After etching (Fig. 5) a coarse-grained structure was revealed with no evidence of preferential oxidation at the grain boundaries, and there was very little indication of oxide inclusions along the stringers which consisted of a series of small bright metallic particles.

(iii) Diffusion between the nickel-chromium coating and the molybdenum base resulted in a very hard (ca 1500 H.V.*) intermetallic compound about 1 mil thick, presumably containing nickel, chromium and molybdenum (Figs. 4 and 5).

(iv) With the multilayer coatings, no evidence was seen of the gross sub-cutaneous oxidation reported by Couch et al[8] in connection with duplex coatings of chromium-nickel.

Significant features, observed on sections of specimens associated with each of the two distinct modes of failure viz., local penetration or detachment of the coating, were as follows:

(a) *Local Penetration*

Failed test pieces of this type were characterised by the presence on the surface of the oxide layer of blisters of varying size. They were mostly very small however and, in general, could only be detected on microscopic examination of the cross-sections. The blistering was confined to the oxide layers and no examples were seen in which the entire metallic deposit itself blistered away from the molybdenum. By selecting blisters at varying stages of development, an attempt was made to identify the progress of such local

* Diamond pyramid indenter, 50 g load.

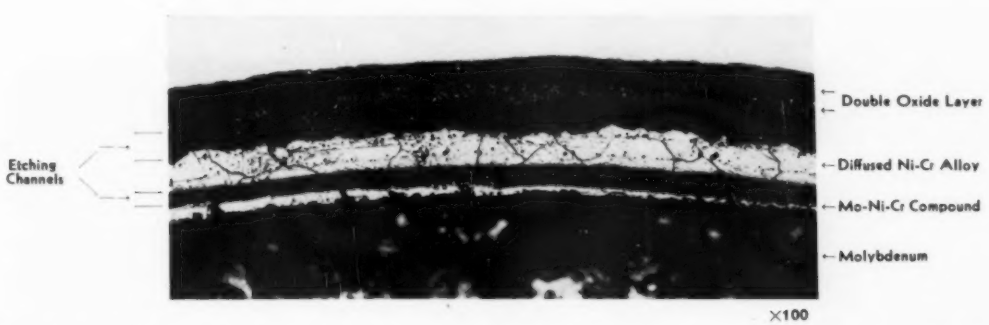


Fig. 5. 5 mil multilayer Ni-Cr coating (nickel outermost) after oxidation for 311 hours at 1100C. (Etched anodically in 2½ per cent oxalic acid.)

failures, and various areas from a section of a failed specimen are shown in Figs. 7(a) to (d). Each blister was associated with an adjacent cavity in the underlying nickel-chromium alloy, which ultimately enlarged sufficiently to expose the molybdenum and to promote consequent failure.

The cavities under large blisters usually contained a reddish-brown non-metallic compound, presumably an oxide.

(b) *Detachment*

Microscopical examination of a longitudinal cross-section of a specimen which had failed by detachment of the deposit from the hemispherical end revealed separation of the coating at some distance from the substrate accompanied by delamination and internal oxidation along planes corresponding to the planes of the outer four chromium deposits of the multilayer coating (Fig. 8). It was observed that the delamination terminated at a short distance from the hemispherical end and the coating along the parallel portion of the specimen remained sound.

A cross-section of the hemispherical end of a specimen which had failed by local penetration at a location remote from the end showed that the process of de-lamination was already far advanced (Figs. 9, 10) and it is evident that both processes of deterioration proceed simultaneously and that which effect produces the final breakdown is a matter of chance.

Swelling of the hemispherical end occurred during oxidation testing in nearly all specimens irrespective of the mode of ultimate failure and examination of cross-sections at this location appeared to show that the local rate of oxidation was considerably greater than along the cylindrical portion.

Three of the four alumina coated specimens failed by detachment or partial detachment at the hemispherical end (Fig. 11).

DISCUSSION

It is apparent from this and previously published work that an electrodeposited 80:20 nickel-chromium coating 5–10 mils thick is potentially capable of protecting molybdenum for several hundred hours at 1100C (2012F) and usually does so. In the present work three to four fifths of the original 5 mil coating remained sound and unoxidised after 300–500 hr. It is clear therefore that the inherent oxidation resistance of a properly diffused coating of this composition is adequate for many purposes and that the most important problem is to elucidate the causes and to seek remedies for those local failures which, in practice, limit the life of the coating.

Basically the effectiveness of a coating depends upon its ability to form a sound and tenacious protective film of oxide which will sustain, without damage, the stresses induced by rapid heating and cooling. This is primarily dependent on the composition of the metallic coating. It is known, for example, that neither nickel nor chromium are satisfactory by themselves and, as shown by Zima,[11] concentrations around 10 per cent of chromium in nickel must be avoided. The diffusion studies of Couch et al[5] based upon duplex coatings of ½ mil chromium plus 1½ mil nickel of nominal 80:20 composition heated at 1100C have shown that the time required to attain equilibrium concentrations of nickel and chromium certainly exceeds, and possibly greatly exceeds, 100 hr. Throughout a large proportion of the life of the coating therefore, the outer regions of the coating will consist of either nickel or of the undesirable chromium-weak alloys. From this point of view pre-diffusion of a duplex chromium-nickel coating in an inert or a reducing atmosphere might be expected to be beneficial but, owing to the long time at temperature necessary to attain equilibrium, this would entail considerable diffusion of molybdenum into the coating (see below). Couch et al[5] attributed to this factor, the adverse effect on oxidation-life of pre-diffusion in their tests. Safranek and Schaer[5] claimed that, as would be expected, homogenisation is much more rapid with multilayer coatings (e.g. 0.2 mil Cr; 0.8 mil Ni repeated) and our work was therefore mainly based on this type of coating.

We found no significant advantage in prediffusing under the conditions recommended as optimum by these authors

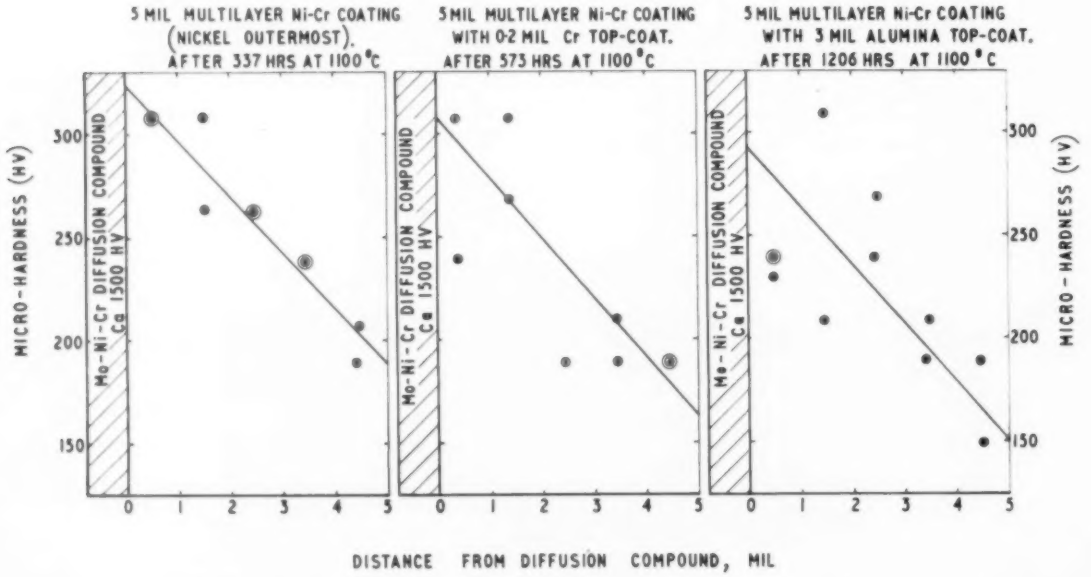

5 MIL MULTILAYER Ni-Cr COATING (NICKEL OUTERMOST). AFTER 337 HRS AT 1100 °C
5 MIL MULTILAYER Ni-Cr COATING WITH 0·2 MIL Cr TOP-COAT. AFTER 573 HRS AT 1100 °C
5 MIL MULTILAYER Ni-Cr COATING WITH 3 MIL ALUMINA TOP-COAT. AFTER 1206 HRS AT 1100 °C
MICRO-HARDNESS (HV)
Mo-Ni-Cr DIFFUSION COMPOUND Ca 1500 HV
300
250
200
150
0
1
2
3
4
5
DISTANCE FROM DIFFUSION COMPOUND, MIL

Fig. 6. Variation in microhardness across sections of 5 mil multilayer Ni-Cr coatings.

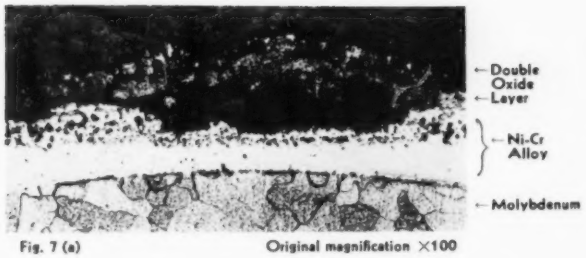


Fig. 7 (a) Original magnification ×100

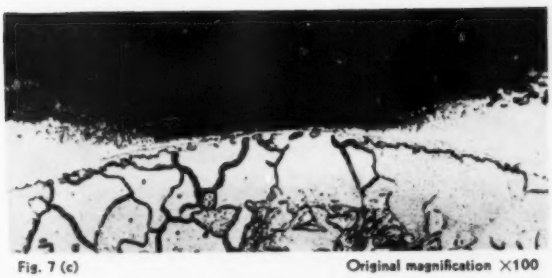


Fig. 7 (c) Original magnification ×100

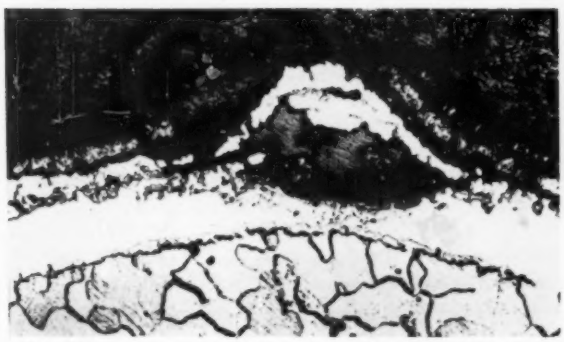


Fig. 7 (b) Original magnification ×100

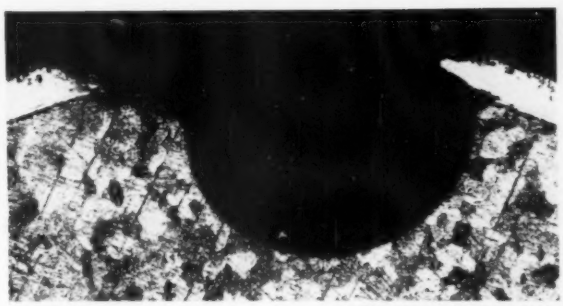


Fig. 7 (d) Original magnification ×100

Fig. 7. Stages of local penetration failure of 5 mil multilayer Ni-Cr coating (Cr outermost) after oxidation for 523 hours at 1100C revealed by cross-sections of different blisters on the same specimen.

(4 hrs at 1100C) although other devices to introduce a higher chromium content in the outer zone viz. by reducing the thickness of the layers or, more especially, by using an outer coat of chromium were much more effective. This suggests, either that complete homogenisation is not attained in 4 hr at 1100C or, more probably, that the progress of oxidation is largely determined by the properties of the oxide skin first formed and that these are improved when the alloy is richer in chromium than the nominal 20 per cent. This suggestion is supported by the greater reproducibility in the oxidation-life of the chromium-rich coatings.

While, as shown, the inherent oxidation resistance of 80:20 nickel-chromium alloy is not the life-determining factor, it is known that it can be improved by alloying additions, for example by adding 4 per cent of aluminum. Couch et al[9] found that the oxidation life of duplex chromium-nickel coatings was materially improved by a top-coat of electrodeposited aluminum and this was attributed to the formation of nickel aluminide. Betteridge[12] found small additions of reactive metals such as calcium, cerium, zirconium, thorium or silicon improved the adhesion of the scale formed in 80:20 nickel-chromium alloys, conferring greater resistance to thermal shock. The author attributed this to preferential oxidation of the reactive metal within the alloy which results in the formation of dispersed globules of oxide ahead of the normal scale layer. These globules, by providing an irregular interface, impart improved keying but, as he points out, this explanation is not clearly applicable to the cerium nitrate dipping treatment. Nevertheless, this treatment when applied to metallurgically produced 80:20 nickel-chromium alloy, has been shown to be effective in improving the thermal shock resistance of this alloy. Our failure to obtain any improvement by this method may have been due, either to the fact that we were primarily testing oxidation resistance with only very limited thermal shock or, more probably, because we applied the cerium nitrate to the outer *nickel*

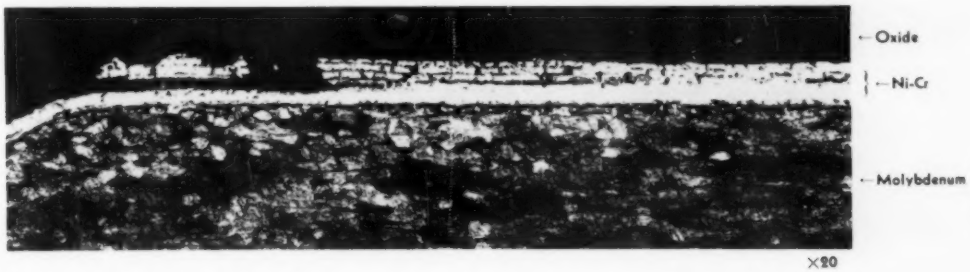


Fig. 8. 5 mil multilayer Ni-Cr coating after oxidation for 573 hours at 1100C; detachment failure.

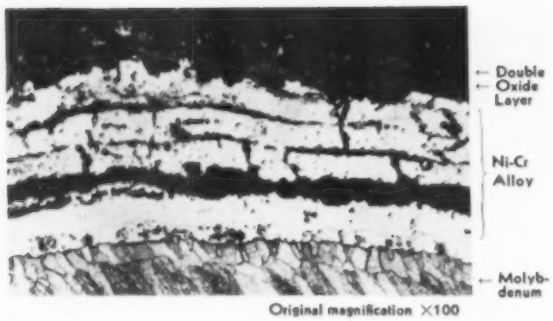


Fig. 9. Hemispherical end of specimen having 5 mil multilayer Ni-Cr coating which failed by local penetration after oxidation for 523 hours at 1100C.

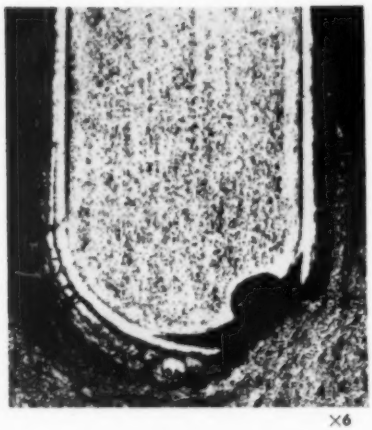


Fig. 11. 5 mil multilayer Ni-Cr coating with 3 mil Alumina, failed after 1206 hours at 1100C. (Longitudinal section.)

layer of a multilayer coating. Further tests are clearly necessary on diffused coatings tested under thermal-shock conditions.

As already indicated there is however ample evidence that the oxidation resistance of 'straight' nickel-chromium coatings is sufficient to protect molybdenum for long periods at 1100C and that the basic difficulty is local breakdown of the coating, usually after several hundred hours, of which two types have been observed in the present work.

The first type is characterised by the formation of blisters in the oxide coating leading ultimately to local penetration. It is necessary therefore to account for the production of the blisters and also a greatly enhanced rate of oxidation at particular blister sites. The specific volume of the oxides which form on metals of high oxidation resistance is known to be greater than that of the metal from which they were formed. It follows that, as oxidation proceeds, compressive stresses will build up in the oxide layer and that these will be greater as the thickness of the oxide increases. During the cooling cycles these compressive stresses will be augmented when the oxide is adherent due to the greater coefficient of contraction of the metallic substrates (molybdenum plus un-oxidised nickel-chromium). The compressive stress can be relieved either by spalling or by the raising of blisters and, in our experience, it has been the latter rather than the former process which occurs. Cracks will almost certainly be formed in the oxide coating constituting the blister and these, by increasing the oxygen supply, will tend to promote more rapid oxidation of the underlying protective coating. However, it is usually found that this proceeds far more rapidly at a particular blister site than at the blisters generally, and it is necessary to find an explanation for this fact. It is possible that a blister which formed early in the oxidation life, or one which was unusually large or heavily cracked, could provide the explanation but this seems unlikely in view of the substantial oxidation resistance of the nickel-chromium alloy. It seems more likely that the local acceleration of oxidation is associated with the outward diffusion of molybdenum which has been demonstrated by Couch et al[8] to proceed to a considerable distance from the interface. If, as seems likely, this diffusion occurs along a wavy front and if the ternary alloy of Ni-Cr-Mo is particularly susceptible to oxidation, the local-spot type of failure could be accounted for by a crest in the molybdenum diffusion front happening to coincide with the increased supply of oxygen at the base of a blister. (Fig. 12.) We know of no direct evidence that the ternary alloy of Ni-Cr-Mo would oxidise rapidly but this seems likely by analogy with the behaviour of the normally resistant alloy of iron containing ten per cent of chromium which, as shown by S. S. Brenner,[14] oxidises rapidly when five per cent of molybdenum is added.

The need for a barrier coating to prevent outward diffusion of the molybdenum has been long recognised but it seems clear from the experimental results that gold is not suitable for use in association with nickel at temperatures above 1000C. (The equilibrium diagram for Au-Ni shows complete solubility above 800C with a minimum in the solidus and

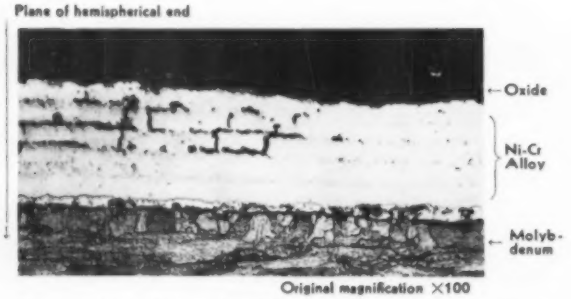


Fig. 10. Limit of internal oxidation along cylindrical portion of specimen adjoining hemispherical end. Specimen as Fig. 9.

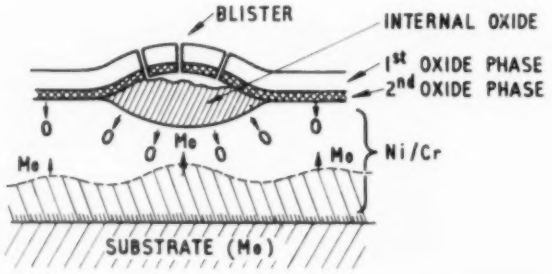


Fig. 12. Suggested mode of failure at site of blister.

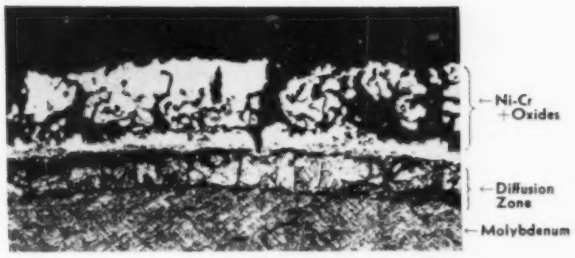


Fig. 13. 1.5 mil gold followed by 5 mil multilayer Ni-Cr coating; after oxidation for 24 hours at 1000C.

liquidus lines at 950C, corresponding to 20 per cent nickel.) It is not known to what extent the interdiffusion of chromium and molybdenum will modify the melting point but it appears from the photomicrograph (Fig. 13) that not only melting of the gold-rich undercoating but also extensive internal oxidation of the nickel-chromium layer contributed to the failure.

The second type of failure, detachment of the hemispherical end of the coating, was clearly determined by the local geometry of the specimen and resembles very closely the "edge separations" observed by Couch et al[8] using duplex coatings on flat specimens. The de-lamination of the coating on our specimens did not occur except at, and adjacent to, the end of the specimen and there seems little doubt that it occurs during the heating cycle due to stresses arising from the greater coefficient of expansion of the nickel-chromium alloy as compared with that of the molybdenum substrate. The same forces are present over the whole of the specimen but, except at the free end, the stresses are contained by reactive forces within the deposit itself.

Incipient or total separation of the coating will occur at the weakest point and it is evident that the residual 'stringers' at the sites of the original chromium deposit constitute planes of weakness. It is not clear whether the internal oxidation along these planes (Figs. 8–10) is the cause or the result of the inter-layer weakness but the virtually complete absence of internal oxidation of the coating on the cylindrical portion of all specimens strongly suggests the latter alternative.

The increased rate of oxidation of the nickel-chromium deposit on the end of the specimen must also be attributed to the local contour. As indicated above, compressive stresses will tend to build up in the oxide scale as oxidation proceeds and this will ensure that any cracks which form on the parallel portion of the specimen will be kept closed. The relative absence of lateral restraint at the free end of the specimen would tend however to encourage radial cracking of the oxide coating, increasing the oxygen supply and accelerating the rate of oxidation locally.

If, as appears to be the case, local separations result from stresses introduced by differential expansion, then this must be regarded as a basic limitation of nickel-chromium coatings and further progress must be along lines which seek to mitigate this effect.

The very marked improvement in oxidation life imparted by a 3 mil top-coat of sprayed alumina represents a partial success in this direction. The Rokide type of coating used is porous and its effectiveness as an oxygen barrier would therefore be expected to be limited. It may be that its effectiveness depends more upon its function as a heat barrier, thereby reducing thermal shock to the underlying metallic coating. A non-porous coating of fused alumina, applied by the plasma-arc process, might give added protection and this is to be tried. The coefficient of expansion of alumina is very similar to that of molybdenum (8.1×10^{-6} and 6.18×10^{-6}°C respectively) and it is possibly for this reason that three of the four samples sustained 35 to 38 cycles of heating and cooling during the preliminary part of the test without visible damage.

CONCLUSIONS

Test-pieces of simple shape in 0.5 per cent Ti molybdenum alloy can be protected from oxidation for several hundred hours at 1100C (2012F) under conditions involving limited thermal cycling by coatings of electrodeposited chromium and nickel of 5 mil total thickness. Multilayer coatings appear to be slightly superior to duplex coatings of the same thickness and significantly greater improvement in life, and possibly also in reproducibility, is obtained by using chromium as the final deposit of the multilayer coating. The failure which ultimately occurs is highly localised and is believed to be associated with two main factors: (i) diffusion of molybdenum into the coating and (ii) local de-lamination of the coating due to stresses set up by differential expansion. Both phenomena are inherent in the molybdenum/nickel-chromium system and fully satisfactory solutions to these problems are not in sight. Nevertheless, as shown by the four-fold increase in oxidation life resulting from a top-coat of sprayed alumina, ameliorative treatments are possible. A further important step would be the discovery of a suitable diffusion barrier to molybdenum.

The results of the present oxidation tests may be regarded as promising but it remains to be established by further tests now in progress, that protection for similar periods can be afforded to specimens and components of more complex shape under conditions of severe thermal cycling.

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Mr. Williams is an Associate of the Institution of Metallurgists and has been a member of the Institute of Metal Finishing since 1947.

R. A. F. Hammond graduated with honours in chemistry from the Royal College of Science, London in 1926 when he was appointed to the Research Department, Woolwich (now the Armament Research and Development Establishment of the Ministry of Supply), working in the Electrodeposition Section under the late Mr. A. W. Hothersall whom he ultimately succeeded as chief in 1950.

He has been associated in the publication as author or joint author of a large number of papers in the field of electrodeposition. His services to the Crown were recognised in the New Year Honours List for 1958 by his appointment as an Officer of the Order of the British Empire which he received at the hands of Her Majesty the Queen.

He has been an active committee member of the Institute of Metal Finishing for many years, a member of the Council since 1947 and held the office of President of the Institute from 1955–1957.

He was elected a Fellow of the Royal Institute of Chemistry in 1950.

He visited the USA in 1950 as Secretary and I.M.F. representative in the British Productivity Team on Metal Finishing under the post-war Economic Co-operation Administration (Marshall Aid) Scheme and again in 1953 when he was engaged upon a technical inquiry for the Ministry of Supply. He presented a paper at the Fifth International Conference on Electrodeposition and Metal Finishing held in Detroit, Michigan, June 15-19, 1959.

APPENDIX

Method of Plating the Test-Pieces

The following sequence of operations was used:

1. Vapour degrease in trichloroethylene.
2. Stop-off the steel stem with wax.
3. Cathodic alkali clean. (5 per cent NaOH; 5 per cent Na_2CO_3); 20 min at 50 A/ft².
4. Rinse.
5. Anodic polish in 1:1 V/V H_2SO_4 (sp gr 1.84): H_3PO_4 (sp gr 1.75) for 3 min; current density 250A/ft², temp 50C (122F).
6. Rinse; inspect for surface defects, and if necessary repeat (5).
7. Scour weld area with pumice and water to remove black smut.
8. Rinse.
9. Immerse in 50 per cent NaOH for 2 min at room temperature.
10. Rinse in distilled water.
11. Transfer to the chromium plating bath making anodic connection before immersion; reverse etch for 1 min at 200 A/ft²; (50C; 122F).
12. Reverse current and plate for requisite time (200 A/ft², 50C).
13. Warm rinse (50C).
14. Nickel strike 10 min, 180 A/ft², 40C (104F), making cathodic connection before immersion.
15. Warm rinse.
16. Nickel plate in sulphamate bath at 40 A/ft², 50C to desired thickness, making cathodic connection before immersion.
17. Warm rinse.
18. Chromium plate to desired thickness and repeat stages 13 to 18 as required.

After rinsing, drying and de-waxing the steel stem, the molybdenum test-piece was stopped off and the stem plated as follows:

1. Scour.
2. Rinse.
3. Cathodic alkali clean.
4. Rinse.
5. Anodic etch in 30 per cent by weight H_2SO_4 for 3 min at 400 A/ft² (room temperature), then reverse current for 3 seconds (if top-coat of multilayer deposit is nickel).
6. Rinse.
7. Chromium plate to a thickness of 3 to 4 mil.
8. Deposit 12 mil nickel after rinsing and striking as detailed above.
9. Rinse, dry and de-wax.

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LEA

ABRASIVE FINISHING METHODS

ALUMINUM and MAGNESIUM

AND THEIR ALLOYS

CASTINGS · FORMINGS · EXTRUSIONS · SPINNINGS · STAMPINGS

Aluminum and Magnesium and their alloys are soft metals with high coefficients of friction and a tendency to be cut away at the grain boundaries if overheated during an abrading operation. These characteristics limit the choice of finishing procedures to those providing sufficient lubrication and those requiring a minimum of pressure.

The objective, of course, is to use the least number of operations permitted by the hardness and original surface to arrive at the desired commercial finish. Recommendations are of necessity rather general, but it is hoped they will serve as a guide. We shall, of course, be glad to make specific recommendations on request after studying samples of work.

POLISHING...A peripheral speed of 5000 sfm is recommended for polishing Aluminum and Magnesium when glue is used to bond the abrasive to the set-up wheel. From 5000 to 7000 sfm would be satisfactory using GRIPMASTER or PLASTI-GLUE cement for bonding the abrasive to the set-up wheels. In either case, the use of bar LUBAR, Clean Grain LUBAR or LIQUALUBE, a liquid lubricant, is necessary to prevent the wheel from loading which slows down the rate of polishing and causes gouging of the surface. Polishing wheels may also be prepared using liquid abrasive-cement compositions, such as LEABRAMENT or PLASTI-BRADE. LEA COMPOUND is frequently used for polishing Aluminum and Magnesium castings with sewed buffs, canvas, felt or leather polishing wheels which have been sized or pre-coated first with bar AD-LEA-SIVE No. 3

The resultant fast-cutting flexible polishing head is top-dressed with LEAROK or LUBAR to produce a smooth metal surface free of adhering dry particles of metal. Such particles would be produced by dry abrasives without the lubrication referred to above and would result in discoloration upon subsequent treatment, such as anodizing.

INTERMEDIATE FLEXIBLE POLISHING...Small defects, flash, etc. are removed and the surface brought to a uniform finish, using a flexible polishing step with a LEA COMPOUND (such as Grade "N") on sewed buffs or loose muslin sections at 4000 to 5000 sfm.

SATIN FINISHING...This is a final finish produced at surface speeds of 3000 to 5000 feet per minute. Use LEA COMPOUND such as Grades "N", "C" or "B-31" on loose muslin buffs, ventilated or bias buffs, string or wick wheels, with or without LEAROK or LUBAR lubricant, according to the line effect desired.

MATTE FINISHING...This is also a final finish, frosted in appearance. Using Grade "C" LEA COMPOUND at 5000 sfm on ⅜" sewed buff wheels will develop the heat necessary to produce the sand blast or frosted type of finish.

BUTLER FINISHING...To produce this final finish showing no surface defects, we suggest Grade "A-1", "B-12" or "MH" LEA COMPOUND on loose muslin buffs at 3000 to 5000 sfm.

BRIGHT FINISHING (Bar Compositions)...For cutting down stampings or extrusions, use Grade 765 LEAROK, at 6000 to 7500 sfm; for coloring, follow this step with Grade 884 LEAROK at the same speed. Use loose muslin buffs for both operations. For cutting down castings, use Grade 406 LEAROK; for coloring, use Grade 309 LEAROK.

BRIGHT FINISHING (Liquid Compositions)...All operations at 6000 to 8000 sfm.

Castings & Extrusions

Heavy Cut—FH77J or UF47J Liquabrade
Cut & Color—TH52P or 4994 Liquabrade
Color—UH20A or UH20D Liquabrade
Buff—Sisal for Heavy Cut; Ventilated or Sewed for Cut and Color; Loose buff for coloring

Stampings & Extrusions

Cut—TH52P or 4994
Color—UH20A or UH20D Liquabrade
Buffs—Ventilated or Sewed

MAGNESIUM ALLOYS

Finishing methods for magnesium and its alloys closely parallel those for aluminum except that certain magnesium alloys do not drag or tear making unnecessary as much lubrication as is usually required with aluminum. Refer to above for general procedure.

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ABRASIVE FINISHING
ALUMINUM and MAGNESIUM
and their alloys

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◀ INDICATE A 127.

ANNUAL MEANS BY WHICH AES RECOGNIZES ITS MEMBERS' DISTINGUISHED SERVICE

AES HONORS

AES HONORARY MEMBERSHIP is granted upon nomination by a Branch, selection by the Honorary Awards Committee, ratification by the Executive Board, and election by the Supreme Society.

The AES AWARD OF MERIT is granted by the Executive Board to members for meritorious service to the Society.

ACHIEVEMENT AWARDS

The Society's highest Scientific Award is its AES SCIENTIFIC ACHIEVEMENT AWARD presented annually to the member who by "decade plus" accomplishments has advanced the theory and practice of electroplating, metal finishing and allied arts—or raised the quality of processes and products—or enhanced the dignity of the profession. Selected by a committee from among nominations of AES Branches, the awardee delivers the "William Blum Lecture" at the next year's Annual Convention. He receives a scroll and a $500 honorarium plus other recognition.

The CHARLES HENRY PROCTOR MEMORIAL LEADERSHIP AWARD is AES's highest administrative honor. A Selection Committee chooses the year's winner from among Branch and Committee nominations. Sponsored by Mr. and Mrs. William Osborne Preston, son-in-law and daughter respectively of Charles Henry Proctor, founder of AES, the Award consists of a handsome laminated scroll, a $150 cash award and attendant recognition. It is awarded at the Farewell Banquet at the year's Annual AES National Convention.

TECHNICAL PAPER AWARDS

THE CARL E. HEUSSNER AWARD, consisting of the AES Gold Medal, plus a cash award of $250, and an Award Certificate, for the best paper printed in Society publications during the fiscal year. (Co-sponsored by the Society and United Platers' Foundation, Glenn H. Friedt, Trustee.)

THE AES SILVER MEDAL, consisting of a cash award of $150 for the second best PLATING or convention paper during the fiscal year.

THE AES BRONZE MEDAL, consisting of a cash award of $50 for the third best PLATING or convention paper during the fiscal year.

PRESENTATION OF AWARDS AT LOS ANGELES CONVENTION

(1) Award of Merit bestowed upon Past National President Herberth E. Head, left, by President W. Andrew Wesley. (2) Then President Ralph D. Wysong pinning Honorary Membership pin on Past National President Frederick Fulforth. (3) National First Vice President Chester G. Borlet presenting Membership Award to Earl Coffin, Los Angeles Branch, winner in Division A Branch Membership Competition.

TECHNICAL PAPER AWARDS

NICKEL PLATING

THE GEORGE B. HOGABOOM MEMORIAL AWARD, consisting of $75 and an Award Certificate, for the best paper on nickel plating printed in Society publications during the fiscal year. (Sponsored by the Society and its Hartford Branch.)

COPPER PLATING

THE JOHN J. HANNEY MEMORIAL AWARD, consisting of $75 and an Award Certificate, for the best paper on copper plating printed in Society publications during the fiscal year. (Sponsored by the Society's Grand Rapids Branch and the Metal & Thermit Corporation.)

MECHANICAL FINISHING

THE ROBERT S. LEATHER MECHANICAL FINISHING AWARD, consisting of $50 and an Award Certificate, for the best paper on the subject of mechanical finishing appearing in Society publications during the fiscal year. (Sponsored by the Lea Manufacturing Co.)

ZINC PLATING

THE ZINC AWARD OF AES, consisting of $50 and an Award Certificate, for the best paper on the plating of zinc die castings appearing in the AES's publications during the fiscal year. (Sponsored by the American Zinc Institute.)

PRECIOUS METAL PLATING

THE PRECIOUS METAL PLATING AWARD OF AES, consisting of $50 and an Award Certificate for the best paper on the plating of platinum, palladium, rhodium, iridium, ruthenium, gold or silver appearing in the Society's publications during the fiscal year. (Sponsored by the International Nickel Company, Inc.)

CHROMIUM PLATING

THE CHROMIUM PLATING AWARD, consisting of $50 and an Award Certificate, for the best paper on the subject of chromium plating appearing in Society publications during the fiscal year. (Sponsored by the Nutmeg Chrome Corporation.)

ORGANIC FINISHING

THE ORGANIC FINISHING AWARD OF AES, consisting of $50 and an Award Certificate for the best paper on the subject of organic finishing appearing in the Society's publications during the fiscal year. (Sponsored by the O'Brien Corporation of South Bend, Indiana, Industrial Finishing Division.)

ALUMINUM FINISHING

THE ALUMINUM FINISHING AWARD OF AES, consisting of $100 and an Award Certificate for the best paper on the subject of aluminum and its chemical treatment appearing in the Society's publications during the fiscal year. (Sponsored by the Kaiser Aluminum & Chemical Company.)

BRANCH MEMBERSHIP EXPANSION

The 59 Chartered Branches of American Electroplaters' Society, Inc. in the United States, Canada and Australia are grouped by numerical stature into three Divisions, namely A (126 members or over); B (70–125 members) and C (under 70 members). To that Branch in each Division making the largest net membership growth during the year, an award of $50 is bestowed at each year's Annual Meeting of the Supreme Society.

AES AWARD RECOGNITION FOR THE YEAR 1959–1960

(Left) Dr. A. Kenneth Graham holding AES Scientific Achievement Award Scroll presented to him by then National President Ralph D. Wysong. (Center) Presentation of the Charles Henry Proctor Memorial Leadership Award to Past National President Walter L. Pinner, left, Mr. and Mrs. William Osborn Preston, donors, and National President W. Andrew Wesley, who made the presentation. (Right) A. W. Wallbank of England receives from President Wysong, the Heussner Gold Medal Award for the best paper published in AES publications during the year.

INTERNATIONAL CONFERENCES ON ELECTRODEPOSITION AND METAL FINISHING

"The conception of periodic International Conferences on Electrodeposition," wrote Dr. Simon Wernick, Honorary Secretary of both the International Council of Electrodeposition and Metal Finishing and of the Institute of Metal Finishing (England) in the September 1958 issue of PLATING MAGAZINE, "came initially from the Institute of Metal Finishing which was then known as the Electrodepositors' Technical Society. It resulted from the observation that, at annual conferences of the Society, there was always a goodly sprinkling of overseas delegates who found it worthwhile to attend such conferences.

"The International Conference," continued Dr. Wernick, was accordingly organized by the Electrodepositors' Technical Society in 1937 in London.

"The second such conference was planned for 1939, to be held in Asbury Park, N. J. under the auspices of the American Electroplaters' Society (AES). Such a conference was in fact held but due to the times being unpropitious, there was unfortunately little overseas representation. However, it was counted as International Conference No. 2.

"The Third International Conference took place in London in 1947, again under the auspices of the Electrodepositors' Technical Society. It was not until the fourth such conference—held in 1954—that an international organization was created called the International Council for Electrodeposition to plan future international conferences as one of its terms of reference. The initial member organizations of the Council were: The Institute of Metal Finishing (IMF); The American Electroplaters' Society; and a small Belgian technical group interested in electrodeposition. This conference was again eventually organized by the IMF and held in London.

"It was then resolved that international conferences should be held at five-yearly intervals and accordingly it was decided that the Fifth International Conference would take place in Detroit in 1959 with the American Electroplaters' Society as the host organization and the planning to be carried out by the International Council for Electrodeposition and Metal Finishing (organic finishing was now brought into the orbit of metal treatments). Mr. Walter L. Pinner of the AES was elected Chairman of the present International Council with Dr. S. Wernick of England as Honorary Secretary.

"Despite the fact that the members of this Council are separated by a distance of some 3000 miles, the planning of the Fifth International Conference has been going on apace and it is believed that, as a result, there will be very satisfactory international representation both in respect of authors of papers and those attending the Conference."

THE MAMMOTH FIFTH CONFERENCE

The Fifth International Conference on Electrodeposition and Metal Finishing, a major element of the GOLDEN JUBILEE CONVENTION and Industrial Finishing Exposition of American Electroplaters' Society, Inc. (AES) that was held in Detroit, Michigan, June 15-19, 1959 with the AES's outstanding Detroit Branch as Host, was a mammoth educational enterprise that not only featured the 43 technical papers on electroplating, metal finishing, organic coating and allied arts of experts from the United States, England, Canada, Australia, France, Germany, Holland, India and Italy but which also brought together one of the largest international audiences of scientists and technicians to benefit from them in the half-century history of AES. Attendance at the Conference's nine sessions reportedly averaged over 500 participants each.

These papers, plus the transcript of the discussion that attended the delivery of each such paper at the Conference, were then published by AES in the internationally acclaimed GOLDEN JUBILEE EDITION of its annual book TECHNICAL PROCEEDINGS (1959). "We have a record in this part of the U.S. Department of Commerce of some 5000 National Associations and Societies," wrote a prominent executive of that American governmental agency. "Your volume (TECHNICAL PROCEEDINGS—1959 Edition) is one of the finest reports of its type which we have had the pleasure of seeing prepared by an Association."

Under the supervision of the AES' Editorial Board, in collaboration with the International Council on Electrodeposition and Metal Finishing, the Fifth International Conference was planned for the AES by AES Past President Walter L. Pinner, Chairman of the International Council. His Committee included Dr. T. P. Hoar, Dr. Simon Wernick, A. W. Wallbank, R. A. F. Hammond and George Gardam of England and Myron B. Diggin, Dr. Walter R. Meyer and Dr. Richard B. Saltonstall of the United States.

LOOKING AHEAD TO 1964

International electroplating and metal finishing is looking ahead to the Sixth International Conference. To be held in London in 1964, it looms large as another forward milestone in the advancement of electroplating, metal finishing and allied arts, internationally.

FIFTH INTERNATIONAL CONFERENCE IN SESSION IN DETROIT, JUNE 1959

(1) Walter L. Pinner, chairman of the International Council, opens the Fifth International Conference on Electrodeposition and Metal Finishing. (2) Vast audience at the first session of the Conference. (3) Dr. T. P. Hoar, president, Institute of Metal Finishing, London. (4) Dr. William Blum, first winner of the AES Scientific Achievement Award, at the conclusion of his delivery of the first "William Blum Lecture," receives honorarium and plaque from AES President H. E. Head. (5) Members of the International Council for Electrodeposition, (l to r) R. A. F. Hammond, Dr. T. P. Hoar, Myron B. Diggin, Dr. Simon Wernick, Walter L. Pinner, A. W. Wallbank, Dr. Richard B. Saltonstall, A. A. B. Harvey and Dr. Walter R. Meyer.

AES NEWS

LIFT! HELP YOUR BRANCH ATTAIN ITS MEMBERSHIP EXPANSION GOAL

PUBLISHING SPECIFICATIONS FOR PLATING AUTHORS

So as to assist authors interested in submitting manuscripts of original technical, scientific or practical plating papers for publishing consideration by PLATING MAGAZINE, a handy booklet is available at PLATING titled, "Publishing Specifications for PLATING MAGAZINE Authors."

Papers are considered on the basis of those specifications. A copy of the printed little booklet will gladly be sent to any potential author desiring to submit any such original paper for PLATING evaluation. All PLATING papers accepted and published have, of course, first been favorably considered by three anonymous "reviewers", each qualified on the subject, specifically appointed to consider that particular paper.

AES LAPEL BUTTONS

The AES member's handsome sterling silver lapel button can be purchased from your Branch Secretary at $1.38 per button including tax. These, in turn, can be purchased by Branch Secretaries from National Headquarters at that amount. The silver Branch Past President's button can be purchased by Branch Secretaries from the National Office at $1.43 per button including tax.

For cleaning these sterling silver buttons, here is one expert member's reported method, "Place hot water in which a little washing soda has been dissolved into an aluminum pan or any container with a small piece of aluminum at bottom (concentration: one tablespoonful of soda to one quart of water). Immerse the button so as to touch aluminum, and allow to soak until tarnish disappears. Operation will clean but will not injure the silver."

EXECUTIVE BOARD'S DECEMBER MEETING FEATURED INTENSIVE LONG RANGE PLANNING

Meeting in a full-day's busy regular session at the Statler Hilton Hotel, Detroit, Michigan, Saturday, December 3, 1960, with National President W. Andrew Wesley presiding, the Executive Board disposed not only a number of policy matters, including important management matters brought for consideration or referred to that meeting by its October 28 special meeting, but also engaged in intensive short-range and long-range planning.

Among other business, it named Howard J. McAleer, President of the Formax Manufacturing Company, Detroit, Michigan, as Chairman of the AES Exposition Committee to conduct AES's Sixth Industrial Finishing Exposition in St. Louis, June 16–18, 1964 concurrently with the Society's FIFTY-FIRST ANNUAL CONVENTION to occur there hosted by the AES's St. Louis Branch.

Among other subjects upon which it acted, aside from matters of financial management always stressed, it ratified its Letter Ballot action vesting a temporary charter in the San Diego Branch effective November 1, 1960. It accepted the invitation of the Kaiser Aluminum and Chemicat Corporation to sponsor an annual technical Paper Award titled "Aluminum Finishing Award of AES" (sponsored by the Kaiser Aluminum and Chemical Corporation). It commended the quality of the 1960 Edition of TECHNICAL PROCEEDINGS, and the dispatch with which it was effectively published by November 15.

It dealt at length with AES membership expansion. It acted upon specific recommendations made on specific subjects by AES standing and special committees, including a number of book publishing proposals. It finalized the Agenda of the coming Eighth Interim Meeting of the Supreme Society, and framed at least one proposed amendment to the AES Bylaws. It discussed its share of the informal agenda of the coming joint meeting with the Board of Trustees of the Metal Finishing Suppliers Association.

Present beside the National President were First Vice President Chester G. Borlet, Second Vice President Manuel Ben, Third Vice President Frank O. Beucknan, Immediate Past President Ralph D. Wysong and National Executive Secretary John P. Nichols.

CONVENTION PAPER REPRINTS CAN BE PURCHASED IN QUANTITY

The 1960 Edition of the book, TECHNICAL PROCEEDINGS of American Electroplaters' Society, Inc. (AES) has been completed, and copies of that treasure chest of knowledge on electroplating, metal finishing and allied arts were issued to members in good standing of the Society as of November 1, 1960, internationally, in late November, a publishing time record. By his AES membership, each such member was entitled to such a free copy. A limited quantity of extra copies is now available for sale to AES non-members on strictly a "first-come, first-served basis" so long as that limited extra quantity lasts. (See advertisement pages 20 and 21.)

Not only does the 1960 book contain each of the 31 papers delivered by experts before the educational sessions of the AES's 47th Annual Convention held in Los Angeles, California, July 24–28, 1960 but it also includes the transcript of the discussion that attended the delivery of each such paper.

For those companies or individuals desiring to purchase a quantity of reprints of any of the copyrighted papers appearing in that AES book (other than those delivered before the "Hydrogen Embrittlement in Metal Finishing" Symposium of that AES National Convention), there is a price list available upon request, specifying cost and how to order. Address your request for information to Thomas W. Lowe, Production Manager, TECHNICAL PROCEEDINGS, American Electroplaters' Society, Inc., American Building, 443–445 Broad Street, Newark 2, N. J.

H. J. McAleer

A. P. Julius

ST. LOUIS 1964 AES CONVENTION AND EXPOSITION TO HAVE STRONG LEADERSHIP

Howard J. McAleer, President of the Formax Manufacturing Company, Detroit, Michigan, and General Chairman of the Fifth Industrial Finishing Exposition of American Electroplaters' Society held in Detroit in June 1959 concurrently with AES's mammoth GOLDEN JUBILEE CONVENTION, has been appointed General Chairman of AES's Sixth Industrial Finishing Exposition to be held in St. Louis, June 16–18, 1964, according to an Executive Board announcement.

A Past President of the Detroit Branch, a former member of the Society's Editorial Board, an Award of Merit winner to name but a few of his AES accomplishments, Mr. McAleer will bring experienced leadership and a creditable Exposition management record to AES's coming St. Louis Exposition.

That Exposition will be held in the renowned Keil Auditorium of that municipality simultaneously with the AES's FIFTY-FIRST ANNUAL CONVENTION that will be hosted by AES's St. Louis Branch. Dynamic Anthony P. Julius of the Hager Hinge Company, St. Louis, is the Convention's General Chairman.

Photo Courtesy Historical Collection, Union Title Insurance Company, San Diego, California

SAN DIEGO AS BASE SITE OF AES's PROBATIONARY SIXTIETH BRANCH

Temporarily chartered effective November 1, 1960, AES's probationary Branch at San Diego, California, is taking creditable strides both towards enlarging its Branch membership and in educational performance for its members.

Having successfully operated under Temporary Charter for a minimum of three months, and having reached adequate stature, it will then be eligible to apply for Permanent Charter as AES's 60th Branch. Its President Pro Tempore is Floyd Nick Carter of San Diego. Other temporary officers include Walter Dornbusch as Secretary, Harry Steinke as Treasurer and George Loch as Branch Librarian.

WHAT KIND ARE YOU?

Are you an active member—the kind that would be missed,

Or are you just contented that your name is on the list?

Do you attend the meetings, and mingle with the flock?

Or do you just stay home, and criticize and knock?

Do you take an active part, to help the work along?

Or are you satisfied to be, the kind that just belongs?

Do you ever voluntarily, help at the guiding stick,

Or leave the work to just a few, then talk about the clique?

Come out to the meetings, and help with hand and heart,

Don't be just a member, but take an active part,

Think this over, member, you know right from wrong;

Are you an active member, or do you just belong?

—From AES's
Philadelphia Branch

ANNUAL AES ALUMINUM FINISHING AWARD CREATED

The Executive Board of American Electroplaters' Society, Inc. has just announced the creation of the "Aluminum Finishing Award of AES" as the Society's eleventh annual Paper Award competitively recognizing and rewarding outstanding technical papers on respective technical subjects published in PLATING MAGAZINE or in AES's book TECHNICAL PROCEEDINGS.

Sponsored by the Kaiser Aluminum and Chemical Corporation, the new Aluminum Award consists of a $100 cash award plus a handsome laminated certificate. It will be bestowed annually upon that technical paper on the subject of Aluminum Finishing that during the fiscal year has been published either in PLATING MAGAZINE or in TECHNICAL PROCEEDINGS and which has been adjudged "best" by the Society's Paper Awards Committee.

The new Aluminum Finishing Award expectedly will be presented for the first time at the Business Session of the Supreme Society to be held on the opening day of AES's National Convention at Boston in June 1961.

FUTURE MEETINGS

Education is the business of AES. For National, Regional and Branch educational and other AES meetings ahead, see PLATING's section titled FUTURE MEETINGS herein.

PROCTOR AWARD NOMINATIONS DUE BEFORE APRIL 1

Nominating forms are now in the hands of all AES Branches and Standing Committees thereby enabling such Branches and Committees to enter and support any AES member in good standing whom they please in the competition for the Society's annual "Charles Henry Proctor Memorial Leadership Award". This Award is AES's highest non-technical, non-scientific honor and is intended to recognize and reward 1959–1960's most conspicuous administrative, management, public relations or other deed by an AES member enhancing the welfare, dignity or prestige of the AES and its Branches and members.

To be acceptable to the Selection Committee specified in the rules governing the Award, each Branch's or Committee's nomination must be in the hands of the National Executive Secretary on or before April 1, 1961 on the official form provided by National Headquarters, and each such accomplished form must be certified by the AES Branch or Committee as directed thereupon. Each such form must be accompanied by seven typed copies of the nominated individual's qualifications for the Award.

The winner will be announced at the Farewell Banquet of the AES's 48th Annual Convention in Boston on the evening of June 22, 1961. He will receive a $150 cash award, a handsome scroll, and attendant recognition in PLATING MAGAZINE and TECHNICAL PROCEEDINGS. The Society's National President himself heads the Selection Committee which, besides others, also includes the donors, namely Mr. and Mrs. William O. Preston, son-in-law and daughter respectively of the late Charles Henry Proctor, founding father of AES.

SOME DEVELOPMENTS TO WATCH IN 1961

At the opening of a new year it is desirable to look through a list of recent research achievements in the field of metal finishing to see which developments are now ready for commercial application. The big news a year ago was the success of the multiple-layer nickel-chromium finish in reducing variation of quality in production and in prolonging the average life of bright plated parts. Because of this, and because there will be an increase in total thickness of coatings in 1961 specifications, we find manufacturers daring to call to the attention of the consumer the good quality and permanence of the plated finish they will offer on their new products.

Improved processes for plating on aluminum alloys will be announced in 1961 but details have not yet been released. More is known about another new development. In this, nickel deposits are built up with fine particles of a hard material or of a material with lubricating properties dispersed throughout the coating. Such deposits, incorporating particles of aluminum oxide or the carbides of silicon, titanium, chromium or tungsten, show remarkable resistance to wear. Several applications of this process are now out of the experimental stage.

1961 should be the year for commercial exploitation of new processes for "electroless" plating. Electroless copper, palladium and cobalt will be available as well as new immersion or displacement coatings of platinum and gold. Not yet out of the laboratory stage are electroless processes for depositing chromium, iron and alloys of vanadium.

Finally, the uses of plating for prevention of stress corrosion cracking, hydrogen embrittlement and corrosion fatigue, known for some years to the laboratory man, should begin to reach commercial application soon. In response to the incessant demands of designers of machines, airplanes and missiles for alloys of higher and higher mechanical properties, metallurgists are pushing the various mechanisms for hardening alloys to the limit where susceptibility to embrittlement or cracking is introduced. Damage of this kind often actually originates at or through the surface of the metal. It is now becoming appreciated in industry that the most economical way to take full advantage of alloy strength capabilities without risking cracking or corrosion fatigue often is simply to apply an appropriate plated coating.

Prediction of future events is always dangerous. There will, of course, be other significant new developments during the year. Those named above are a list compiled by only one observer, namely, the undersigned.

W. A. Wesley
President
American Electroplaters' Society

EMPIRE STATE TO COMMEMORATE ROCHESTER BRANCH'S GOLDEN JUBILEE

To commemorate the FIFTIETH ANNIVERSARY of the AES's Rochester Branch, the Empire State Regional Council, with the Rochester Branch as host, will team that Region's Seventh Annual Empire State Educational Meeting with the Rochester Branch's GOLDEN JUBILEE so as to create a gala two-day event to be held May 5–6, 1961 at the Manger Hotel, Rochester, N. Y. Cooperating will be the Region's Six Branches, namely Buffalo, Syracuse, Mohawk Valley, Capitol District, Southern Tier and Rochester.

The widely anticipated event will make its debut Friday evening, May 5 with registration and a "Get Acquainted Party" that will include dancing. On Saturday afternoon, May 6, there will be dual Educational Sessions featuring outstanding technical papers by outstanding technical speakers. One session will be focussed upon electroplating and metal finishing; the other upon organic coating. Elsewhere, the ladies will participate in an ambitious Ladies Program.

The Rochester FIFTIETH ANNIVERSARY observance and concurrent Seventh Annual Regional Educational Meeting will be climaxed Saturday evening by a gala banquet, entertainment and dance.

CHANGED YOUR ADDRESS LATELY?

To insure prompt and uninterrupted servicing of your PLATING MAGAZINE, please fill out this form:

NAME.....

OLD ADDRESS.....

CITY.....STATE.....

NEW ADDRESS.....

CITY.....STATE.....

QUALITY CONTROL TOPIC FOR GRAND RAPIDS ANNUAL MEETING

On Saturday, January 21, Grand Rapids will present both morning and afternoon Technical Sessions at its Annual Meeting at the Pantlind Hotel.

At the morning session, Charles Martin of the Household Refrigerator Department, General Electric Corporation, Appliance Park, Louisville, Kentucky, will talk on "Quality Control Procedure on Plated Components in the Appliance Field." The afternoon session will deal with the same subject in the automotive industry and it will be presented by an expert in the field.

It is expected that 500 members, wives and guests will attend the Banquet that same evening. The Banquet will include dancing and entertainment—and refreshments will be provided by the suppliers.

♦

PLATING PRACTICES OUTSIDE USA TO BE HEARD AT CHICAGO ANNUAL

The Chicago Branch Annual Educational Session and Banquet will take place at the Conrad Hilton Hotel in Chicago on Saturday, January 28.

The educational program has been arranged by Simon P. Gary, librarian of the Chicago Branch. He will present Ezra A. Blount, editor of *Products Finishing*, who will talk on "Plating Practices in Japan and the Far East," and Myron B. Diggin, technical director of Hanson-Van Winkle-Munning Company, whose topic will be "Plating Practices in Europe and Asia."

R. Scott Modjeska, chairman of the Banquet Committee, promises that the dinner and entertainment will match the high standard always provided at the Chicago annual events.

♦

CLEVELAND SPEAKERS AT CLEVELAND BRANCH ANNUAL MEETING

The dates for the Annual Technical Session and Dinner Dance of the Cleveland Branch are January 27 and 28. Two well-known speakers have been announced for this annual event.

The Technical Session will be held on Friday night, the 27th, at the Cleveland Engineering Society Building. A. H. DuRose of the Harshaw Chemical Company and a past chairman of the Research Committee of the American Electroplaters' Society will talk on "Electroplating—Art or Science." The subject chosen by C. H. Junge is "Metallurgy and Electroplating." Mr. Junge is with the Cleveland Graphite Bronze Company.

The Dinner Dance will be held on the following evening at the Hotel Carter in Cleveland. It promises to be a gala affair.

AUTOMOTIVE DECORATIVE TRIM SYMPOSIUM FEATURED DETROIT EVENT

Before a large audience of Detroit Branch members, members from many other Branches and a number of AES guests, the Detroit Branch of American Electroplaters' Society conducted a highly commended Symposium on the subject of "Service Performance of Automotive Decorative Trim" in the Wayne Room of the Statler-Hilton Hotel, Friday evening, December 2. It was forerunner of the gala Detroit Branch Christmas Banquet, Entertainment and Dance that packed that hotel on the following evening.

Fourth of a monthly series of outstandingly attended and lauded symposia conducted by AES's largest Branch since September 1960, the panel of speakers included Harold A. Kahler, General Motors Corporation; Vincent Cassidy, Ford Motor Company, and G. G. Levy, Chrysler Corporation. A large number of audience questions were asked and answered by the speakers after formal presentation of their creditable papers.

The Symposium was arranged by Richard A. Fellows, Udylite Corporation, who is the Detroit Branch's 1960–1961 Educational Chairman. National President W. Andrew Wesley served as the Symposium's Chairman. A reception by the Detroit Branch followed the evening's Educational Session.

That Friday evening Educational Session was preceded by a dinner meeting of the Detroit Branch's Executive Group, the Branch's governing council, at which all six of the Society's National Officers, plus the evening's panel speakers, were honored guests of the Branch. Branch President Frederick Olmstead presided.

The Executive Board conducted a full-day's regular meeting at the same hotel, Saturday, December 3. The Board of Trustees of the Metal Finishing Suppliers' Association (MFSA) also met that afternoon.

Following a cocktail party hosted by the member companies of the MFSA, the Detroit Branch banquet, entertainment and dance delighted a huge attendance of Branch members and their wives; visiting AES members from other AES Branches and their wives; and a large number of guests of the Detroit Branch. During the dance held after the banquet and entertainment, the MFSA members' joint hospitality room was a delightful and popular mecca for fellowship and refreshments.

Robert A. Ehrhardt

Dr. R. B. Saltonstall

Dr. H. Narcus

MOTHER BRANCH'S 52nd ANNUAL MEETING, FEBRUARY 4

The Annual Technical Session and Banquet of the New York Branch will be held on Saturday, February 4, 1961. The technical session will start at 2:30 p.m. and will be followed by a cocktail party to be sponsored by the Metal Finishing Suppliers Association. The banquet will start at 7:30 p.m.

Speakers for the afternoon technical session are as follows: Mr. Robert A. Ehrhardt, Bell Telephone Laboratories, Inc. who will talk on "Acid Gold Plating;" Dr. Richard B. Saltonstall, Udylite Corporation, whose subject will be "Duplex Nickel Plating" and Dr. Harold Narcus, consultant, Enthone Company, who will discuss "The Role of the Electroplater in the Printed Circuit and Allied Fields."

HOST: AES NEW ENGLAND REGIONAL

INTERIM MEETING REPORTER

STATLER-HILTON HOTEL HARTFORD, CONN. FEBRUARY 11, 1961

EIGHTH INTERIM MEETING

SUPREME SOCIETY

AMERICAN ELECTROPLATERS' SOCIETY, INC.

STATLER-HILTON HOTEL
HARTFORD, CONNECTICUT

FEBRUARY 10-12, 1961

FRIDAY, FEBRUARY 10

9:00 a.m.—Executive Board Meeting
Executive Suite

8:00 p.m.—Annual Joint Meeting, Executive Board; American Electroplaters' Society (AES) and Board of Trustees, Metal Finishing Suppliers' Association (MFSA)
(To be announced)

SATURDAY, FEBRUARY 11

9:00 a.m.—Registration, Delegates and Alternate Delegates (AES) *Mezzanine*

10:00 a.m.—Eighth Interim Meeting, Supreme Society, AES *Hartford Room*

1:00 p.m.—Luncheon, Delegates/Alternates, AES (Dutch Treat) *Rooms 408-12-16-20*

2:00 p.m.—Eighth Interim Meeting, Supreme Society, AES *Hartford Room*

5–6:00 p.m.—Reception to Delegates/Alternates, AES

8:00 p.m.—"Old Timers' Night", New England Regional Council and Delegates/Alternates (Dutch Treat)
Saengerbund Hall, 266 Washington St., Hartford, Conn.

SUNDAY, FEBRUARY 12

9:00 a.m.—Executive Board Meeting
Executive Suite

"OLD TIMERS NIGHT" TO ROUND OUT EIGHTH INTERIM MEETING

As a feature of the EIGHTH INTERIM MEETING of the Supreme Society to be held at the Statler-Hilton Hotel, Hartford, Connecticut, Saturday, February 11, 1961, the sponsoring AES New England Regional Council will conduct a gala "Dutch Treat" OLD TIMER'S NIGHT at the Saengerbund Hall, Hartford, that same Saturday evening.

Each of the AES New England Regional Group's Branches, namely Bridgeport, Hartford, New Haven, Waterbury and Springfield is reportedly planning to pick its oldest "Old Timer" and sponsor him at the affair. The winning "Old Timer" will be recognized and honored.

Each National Officer, Branch Delegate, Branch Alternate Delegate or Branch representative attending the EIGHTH INTERIM MEETING, plus members, of course, of Branches composing the New England region, will be welcome to attend this novel "Dutch Treat" event.

♦

AES AND MFSA BOARDS IN FOURTH ANNUAL JOINT MEETING

On Friday evening, February 10, 1960, in the Statler Hilton Hotel, Hartford, Connecticut, the Executive Board of American Electroplaters' Society (AES) and the Board of Trustees of the Metal Finishing Suppliers Association (MFSA) will participate in a joint meeting for the fourth annual time.

The two bodies will discuss matters of mutual interest. Dr. W. Andrew Wesley of the International Nickel Company is current President of AES, Frederick P. Green, Crown Rheostat and Supply Company, is the current head of MFSA.

The ultra modern Statler-Hilton Hotel in Hartford, Connecticut, where the AES Supreme Society will hold its Eighth Interim Meeting.

TENTATIVE AGENDA
EIGHTH
INTERIM MEETING
AES
SUPREME SOCIETY

STATLER-HILTON HOTEL
HARTFORD, CONN.

FEBRUARY 11, 1961

1. Welcome by New England Regional Council
2. Welcome by National President
3. Opening of the Session as an Interim Meeting.

   Purpose of the meeting as a sounding board on matters for subsequent consideration and action by the Supreme Society at its Annual Meeting in Boston, June 22, 1961

4. Progress and Status Reports:

   Financial by President

   Educational by First Vice President

   Membership by Second Vice President

   Branch Regionalization, Regional Annual Meetings and Branch Monthly Meetings as Tools of AES Educational Mission by Third Vice President

   Honorary, Merit and Achievement Awards as Inducements for Greater AES Service by Immediate Past President,

   Headquarters and AES Publishing and Public Relations by National Executive Secretary

   AES Research Program by Chairman, Research Committee

5. Preliminary Reports:
   a) Executive Board Appraisal as to AES Financial Structure
   b) Executive Board Recommendations for AES Constitutional and/or Bylaw Amendments If Any
   c) Membership Promotion (Membership Committee Chairman)
   d) Sustaining Member Promotion (Vice Chairman for Finance, Research Committee)

6. AES National Conventions and Interim Meetings
   a) 1961 Boston Convention (Boston Convention General Chairman)
   b) Other AES National Conventions Ahead
   c) Eighth Interim Meeting, Hartford (General Chairman)
   d) Ninth Interim Meeting, Indianapolis
   e) Report of Outcome of Los Angeles Convention
   f) Progress Report on St. Louis Industrial Finishing Exposition (1964)

7. Invitations from Branches to Host 1967 National Convention or 1963 Interim Meeting
8. New Business Brought for Discussion by Delegates
9. Announcement of Candidates for Third Vice Presidency
10. Adjournment

Virginia's picturesque Roanoke Hotel that will serve as locale of the AES Dixie Regional Council's Third Annual Technical Session and Banquet.

FAMED ROANOKE HOTEL AS SITE OF DIXIE'S ANNUAL MEETING

The Blue Ridge Branch will be host for the Third Annual Dixie Regional Technical Session and Banquet to be held on Friday, February 3 and Saturday, February 4 at the Hotel Roanoke, Roanoke, Virginia.

General Electric Company will sponsor a tour of their plant in Salem, Virginia on Friday morning while the ladies will visit the Natural Bridge before attending their luncheon. The MFSA "Get-Together Party" will follow Educational Session A on Friday evening.

Saturday morning will start off with Educational Session B preceding a cocktail party, banquet and dance to be held in the early evening.

Dr. A. L. Pardue of the Virginia Polytechnic Institute will deliver the Keynote address entitled "This Age of Man." Speakers will include C. H. Castle, Abrado Finish Corp., whose subject will be "Application of Barrel Finishing Methods;" H. B. Koehler, Hanson-Van Winkle-Munning Co., will talk on "Rectifier Control in Plating;" C. G. Haupt, Norfolk & Western Railway Co., will explain "Aspects of *p*H in Electroplating;" "The Anode Side of the Story" will be discussed by J. B. Winters, Incar, Inc.; "Japanese Finishing Industry Today" is the topic chosen by Ezra Blount, Products Finishing; and Dr. H. J. Read of the University of Pennsylvania will present "Hydrogen Embrittlement in Electroplating."

The registration fee of $10.00 per person entitles admission to the technical sessions; MFSA's "Get-Together Party;" cocktail party, banquet, ladies' entertainment and door prizes.

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TRI-STATE ANNUAL WILL FEATURE FIVE SPEAKERS

The Columbus Branch of the AES will host the Seventh Annual Tri-State Regional Meeting and Technical Conference on February 4, 1961 at the Deshler Hilton Hotel. Member Branches of Tri-State are Cincinnati, Dayton, Indianapolis, Louisville and Columbus. Every one of these Branches will have large member representation in attendance.

The meeting will begin with 10 a. m. and 2 p. m. Educational Sessions, and will include presentation of five papers by experts in their various fields. Subjects to be discussed are: "Buffing of Zinc Alloy Die Castings," (First Phase of AES Project 18) by William Geissman of the National Lock Company; "Plating on Aluminum," presented by Manuel Ben, General Motors Corporation, and National Second Vice President of the AES; "Developments in Accelerated Corrosion Testing," by Walter L. Pinner of the McGean Chemical Company; "Materials in Outer Space," F. L. LaQue, the International Nickel Company; and "Journey into Ignorance," Richard J. Anderson, Battelle Memorial Institute.

The meeting will conclude with a Cocktail Party, Banquet, Floor Show and Dancing in the evening.

Members of all AES Branches are welcome. Tickets may be secured from P. James Grote, 3513 Roswell Drive, Columbus 13, Ohio.

REMINDERS TO AES CHARTERED BRANCHES

Your Branch's 1960-1961 fiscal year membership expansion quota is 10% over the number of your Branch's members in good standing as at June 30, 1960, meaning 10% more members than your Branch membership on July 1, 1960 before any subsequent suspensions or resignations for 1960-1961 Per Capita Tax purposes.

♦

Your Branch, through its President of record, has been invited to nominate any member of the Society whom it chooses for consideration for the Charles Henry Proctor Memorial Leadership Award for 1960-1961. Signed by both your Branch President and Branch Secretary, your nominating return sheet is due in the hands of the National Executive Secretary by not later than April 1, 1961, accompanied by SEVEN copies of a resume of your nominee's 1959-1960 deeds upon which the nomination is being predicated.

♦

If your Branch is among those very few Branches that have delayed to now in appointing a Branch Research Finance Chairman to spearhead your Branch's effort to stimulate Sustaining Membership applications by industrial companies in your area, with the help of the Regional Research Finance Chairman for your territory, please do so promptly and submit his name to the National Executive Secretary's office at earliest possible time for processing.

HOTEL RESERVATION FORMS AND OTHER DATA CONCERNING THE SOCIETY'S 48th ANNUAL CONVENTION BOSTON, MASS., JUNE 18-23, 1961 WILL ISSUE TO ALL AES MEMBERS WITHIN THE IMMEDIATE FUTURE. YOU ARE URGED TO ACT PROMPTLY TO MAKE YOUR CONVENTION RESERVATIONS.

THE TRI-STATE EVENT'S ARRAY OF SPEAKERS (l. to r.) William Geissman; Manuel Ben; F. L. LaQue; W. L. Pinner and R. J. Anderson.

Boston as seen from Cambridge across the Charles River.

AES's 1961 FAMILY CONVENTION IN THE "HUB OF THE UNIVERSE"

SOME two centuries ago, in the Colonial Days when America was young, every town in Massachusetts had to maintain a tavern or be fined. A license to operate a tavern was given, furthermore, only on condition that it be built near the meeting house. Thus, parishioners could fortify themselves with food and flip[1] before and after the Sabbath's several-hour service in unheated Town Hall. Licensing also required that all good people be in bed at an early hour, and stipulated that "No boots shall be worn in bed."

Two centuries later—during the period from June 18-23, 1961 to be exact—American Electroplaters' Society's members from far and near will converge upon Boston's Statler-Hilton Hotel, a truly modern descendant of the Bay City's Colonial "tavern", to engage in the AES's 48th Annual Convention, and there to be educationally enriched in the arts and the sciences of electroplating, metal finishing and allied arts. Many AES members, moreover, will be accompanied by their wives and children, and the Convention is making heroic plans for their entertainment, relaxation, enjoyment.

FUN AND EDUCATION FOR AES's YOUTH

PARENTS, upon arrival at the Convention, will be able, for example, to purchase a Children's Program ticket book at $15 per youngster which will entitle each such boy or girl to three fun-filled days (Monday, Tuesday and Thursday) of specially planned sightseeing and relaxation, including cost of chaperoned transportation and luncheons.

Whereas the $15 Children's Program book will also entitle each such AES youngster to accompany his or her parents to the Convention's vaunted Clambake, Wednesday, June 21, it will not, however, cover a Banquet ticket. As a dividend, parents of such children can purchase tickets for Thursday night's gala Farewell Banquet for them, if they please, at an additional $8.50 per ticket. To the extent available, moreover, they can purchase tickets for such children for Boston's renowned Pops Concert at an additional $1.50 per such older child.

Yes, to make the Boston Convention stay of AES children in June 1961 as much of a never-to-be-forgotten treat as their Los Angeles Convention adventure of July 1960, the Convention Committee is programming three appealing, well-escorted days in Bostontown and its educational yet joyful environs. Watch PLATING MAGAZINE's monthly Convention Program from month to month as it releases Children's Program details, among others, as they develop.

BOSTON DAYS TO MAKE LADIES' MEMORIES

BEING a Convention where Boston scale and flair will suitably be lavished upon all elements of the AES family, the Society's ladies will be served a program concocted by Ladies Chairman Marjorie Swift that will not only run the gamut of usual Convention social events but which may also add such Bostonian touches (tentatively) as a guided bus tour of the Bay City's famed North Shore, with luncheon perhaps at Crane's Castle in Ipswich, Massachusetts—as a luncheon possibly in the Dorothy Quincy Suite of the John Hancock Building—as other ladies attractions that will sweeten the Bostontown stay of the Society's fair sex.

PLATING's monthly Convention Program will carry the specifics as promptly as programmed by Chairman Swift and her industrious Ladies Committee.

YOUR CONVENTION IN THE "HUB OF THE UNIVERSE"

THE adult registration fee of the 48th Annual Convention will be $25 per adult male or female. This blanket fee will include admittance to all male and female educational, relaxational and entertainment functions of the Convention, including the Clambake, the Boston Pops Concert ("Fun with Fiedler") and the Farewell Banquet.

So attend the AES's 1961 National Convention and enjoy Boston, the metropolis that has given America patriots of old and modern day statesmen; clipper ships and ocean liners to cruise the seven seas; pioneers to settle the plains and the wilderness; scientists to break the secrets of the atom; the financial backing that has built the nation's industries—Boston, the city of many nationalities; of prizewinning newspapers; of sports and champions; of unique homes and restaurants; of great transportation gateways reaching to the lands beyond the horizon—Boston, the matured town of beautiful twilights and cooling Atlantic breezes that will be awaiting YOUR arrival in mid-June 1961.

A ride on the swanboats over the pond in the Public Gardens is a favorite attraction for visitors to the "Hub."

Footnote 1: For "flip", fill a pewter mug with strong beer sweetened with sugar or molasses. Fortify with a generous portion of New England Rum. Fold in whipped cream and beaten egg. Finally, thrust into the mixture a red-hot flip iron. Then savour with delight but also with continence.

CITY OF BOSTON
OFFICE OF THE MAYOR
CITY HALL

JOHN F. COLLINS
Mayor

DECLARATION

WHEREAS, the American Electroplaters' Society, Inc. will hold its 48th Annual Convention in Boston; and

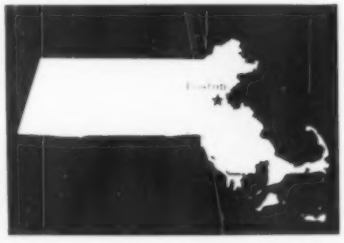
WHEREAS, this Society was created more than a half-century ago for the purpose of fostering technical and scientific knowledge and advancements in electroplating, metal finishing and allied arts; and

WHEREAS, the American Electroplaters' Society (AES) today enjoys a global membership, including many members who are residents of communities in our Commonwealth,

NOW, THEREFORE, I, John F. Collins, Mayor of Boston, do hereby declare the week of June 18-23, 1961 as

"AMERICAN ELECTROPLATERS' WEEK"

John F. Collins
Mayor of Boston



TENTATIVE PROGRAM
FORTY-EIGHTH ANNUAL CONVENTION
AMERICAN ELECTROPLATERS' SOCIETY, INC.
STATLER-HILTON HOTEL, BOSTON, MASSACHUSETTS, JUNE 18-23, 1961

SUNDAY, JUNE 18

9:00 a. m.	Executive Board Meeting (All Day)	AES Headquarters Room
1:00–8:00 p. m.	Registration	Mezzanine
2:00 p. m.	Honorary Membership Award Committee Meeting	Room 418
2:00 p. m.	AES Scientific Achievement Award Committee Meeting	Room 410
4:00 p. m.	Credentials Committee Meeting with Executive Board	Headquarters Room
8:00 p. m.	AES Get-Together Party	Grand Ballroom

MONDAY, JUNE 19

10:00 a. m.	Grand Opening Session	Grand Ballroom
11:00 a. m.	Business Meeting Supreme Society	Grand Ballroom
12:00 noon	Branch Secretaries' Luncheon	Parlor A
12:15 p. m.	Speakers' Luncheon	Parlor F
12:30 p. m.	Ladies Luncheon	Bay State Room
2:00 p. m.	Opening Educational Session (The William Blum Lecture)	Grand Ballroom
2:30 p. m.	Editorial Board Meeting	Parlor C
2:30 p. m.	Educational Session A (Research)	Grand Ballroom
2:30 p. m.	Educational Session B (Organic Finishing)	Georgian Room
4:00 p. m.	Order of Past Presidents Meeting	Hancock Room
6:00 p. m.	Order of Past Presidents Dinner	Hancock Room
8:00 p. m.	MFSA Ball	Grand Ballroom

TUESDAY, JUNE 20

8:00 a. m.	Charles Henry Proctor Memorial Leadership Award Selection Committee Breakfast	Room 418
8:00 a. m.	Speakers' Breakfast	Parlor F
9:00 a. m.–12:30 p. m.	Registration	Mezzanine
9:00 a. m.	Educational Session C (Finishing of Light Metals Symposium)	Grand Ballroom
9:00 a. m.	Membership Committee Meeting	Room 436
9:00 a. m.	Public Relations Committee Meeting	Room 438
9:00 a. m.	Educational Committee Meeting	Room 440
12:00 noon	Joint Educational Committee Meeting and Branch Librarians Luncheon	Parlor A
12:00 noon	Speakers' Luncheon	Parlor F
1:00 p. m.	Ladies Luncheon	(To be Announced)
2:00 p. m.	Educational Session D (Finishing of Light Metals Symposium)	Grand Ballroom
2:00 p. m.	Individual AES Regional Council Meetings (If Any)	(To be Announced)
4:00 p. m.	AES Regional Group and Council Chairmen's Meeting	Room 442
4:30 p. m.	Finishing of Light Metals Forum	Grand Ballroom
8:30 p. m.	"Fun with Fiedler" at Boston Pops	Boston Symphony Hall

WEDNESDAY, JUNE 21

8:00 a. m.	Research Committee Breakfast	Hancock Room
8:00 a. m.	Speakers' Breakfast	Parlor F
9:00 a. m.–12:00 p. m.	Registration	Mezzanine
9:00 a. m.	Educational Session E	Grand Ballroom
9:00 a. m.	Educational Session F	Georgian Room
9:00 a. m.	Research Committee Meeting	Hancock Room
1:30 p. m.	AES Annual Outing (Clambake at Historic Plymouth, Mass.)	Buses from Statler Hotel

THURSDAY, JUNE 22

8:00 a. m.	Speakers' Breakfast	Parlor F
9:00 a. m.	Business Meeting, Supreme Society	Bay State Room
9:00 a. m.	Educational Session G	Grand Ballroom
9:00 a. m.	Educational Session H	(To be Announced)
2:00 p. m.	Business Meeting, Supreme Society	Bay State Room
2:00 p. m.	Educational Session I	(To be Announced)
6:00 p. m.	Cocktail Party	Georgian Room
7:00 p. m.	AES Farewell Banquet	Grand Ballroom

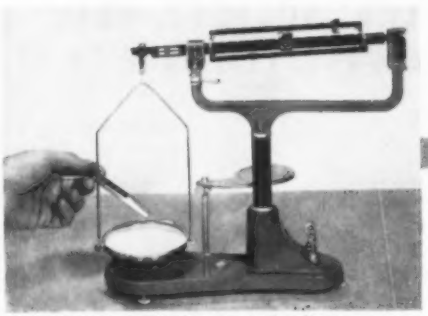
FRIDAY, JUNE 23

8:00 a. m.	Presidents' Breakfast to National Officers and their Families	Parlor C
9:00 a. m.	Executive Board Meeting	AES Headquarters Room

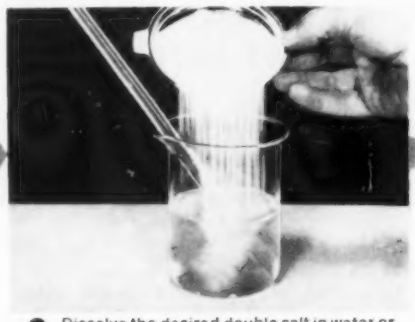
(This is a TENTATIVE PROGRAM as of November 15, 1960. Additions and modifications will be made monthly until finalized.)

Here's how you can save time, and mixing errors with either

New "Direct-Route" Method



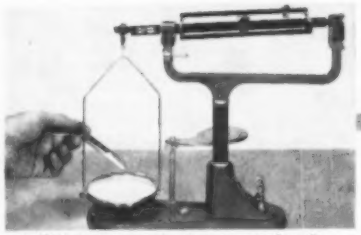
1 Just weigh required amount of sodium-copper or potassium-copper double salt.



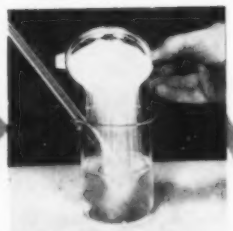
2 Dissolve the desired double salt in water or plating solution.

Laboratory demonstration shows how "direct-route" method saves time

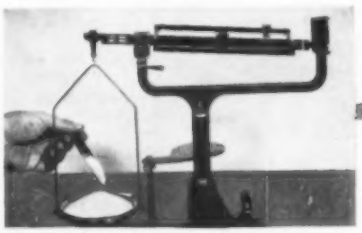
Old "Indirect" Method



1 Weigh out required amount of sodium or potassium cyanide.



2 Dissolve the sodium or potassium cyanide in water.



3 Weigh out the required amount of copper cyanide.

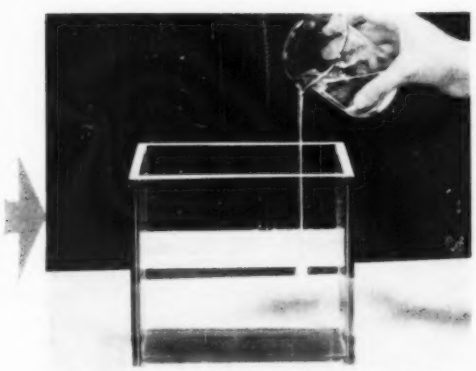
4 Add copper cyanide to water and make a slurry.

5 Dissolve the copper cyanide slurry in solution of sodium or potassium cyanide.

CALL DU PONT FOR ANY ONE OF THESE QUALITY PLATING PRODUCTS. You're assured of superior quality, dependable supply and expert technical service with plating chemicals from Du Pont... your reliable domestic source.

- **Sodium-Copper Cyanide Double Salt**
- **Potassium-Copper Cyanide Double Salt**
- **Copper Cyanide**
- **Potassium Cyanide**
- **All-purpose Cyanobrik® sodium cyanide (in briquette form)**
- **Cyanogran® M sodium cyanide (in granular form)**

reduce handling, avoid waste of Du Pont's Double Salts...



3 Add directly to plating tank—no filtering necessary.

...avoids errors.

6 Add solution through a filter to plating tank.

SODIUM-COPPER CYANIDE
OR
POTASSIUM-COPPER CYANIDE

SAVE TIME AND REDUCE HANDLING...By using one Du Pont copper cyanide double salt instead of two separate chemicals, you eliminate several steps usually required to dissolve copper cyanide. Just weigh out the Du Pont double salt and dissolve it in water or plating solution. A "direct-route" process! (Compare old and new methods at left.)

AVOID WASTE AND MIXING ERRORS...because active ingredients are in the proportions usually required. This simplifies making and replenishing bath . . . prevents waste resulting from undissolved copper cyanide.

INCREASE CONVENIENCE AND SAFETY...With just one salt to dissolve you minimize handling steps. This means greater convenience—more safety.

Du Pont sodium-copper cyanide double salt and potassium-copper cyanide double salt are white, crystalline and readily soluble. They are made from ingredients of highest quality and purity—Du Pont copper cyanide, sodium cyanide and potassium cyanide.

SIMPLIFY CALCULATIONS...Balanced composition of Du Pont double salts makes it easy to determine amounts required for make-up or replenishment. (1 oz. potassium-copper cyanide double salt is equivalent to 0.26 oz. copper, or 0.37 oz. copper cyanide; 1 oz. sodium-copper cyanide double salt is equivalent to 0.29 oz. copper or 0.41 oz. copper cyanide.)

SODIUM-COPPER CYANIDE DOUBLE SALT

	SPECIFICATIONS	TYPICAL ANALYSIS
Copper	28.7% min.	29%
"Free" sodium cyanide	0.4 to 2.0%	1%
Lead	7 ppm. max.	Less than 1 ppm.
Sulfides (as sulfur)	10 ppm. max.	Less than 5 ppm.
Insolubles	0.01% max.	0.01%

POTASSIUM-COPPER CYANIDE DOUBLE SALT

	SPECIFICATIONS	TYPICAL ANALYSIS
Copper	25.8%	26.3%
"Free" potassium cyanide	1.25% to 3.0%	2.9%
Lead	7 ppm. max.	Less than 1 ppm.
Sulfides (as sulfur)	10 ppm. max.	Less than 5 ppm.
Insolubles	0.01% max.	Trace

Both potassium and sodium double salts are shipped in convenient moisture-resistant 100-lb.-net fiber containers.

For further information or Technical Service call your Du Pont distributor or your nearest Du Pont office, listed at left.

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CINCINNATI 2 . . . . 2412 Carew Tower
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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

INTERSOCIETY NEWS

PAXTON RECEIVES INTER-SOCIETY STOUGHTON AWARD

Dr. Harold W. Paxton, 33-year-old Carnegie Institute of Technology associate professor of metallurgical engineering, received American Society for Metals' $2000 Bradley Stoughton Award for outstanding young teachers of metallurgy.

Presentation was made Tuesday, October 18, during the Society's 42nd National Metal Congress and Exposition, October 17–21 in Philadelphia. Occasion was the ASM annual awards luncheon in Philadelphia Trade and Convention Center, site of the exposition. Edward G. Budd Jr., president of The Budd Co., Philadelphia, presented the featured address, "The Acceptance of Change."

The Stoughton Award has been presented annually since 1948 as the ASM Teaching Award. It is now renamed in honor of the late Bradley Stoughton, prominent educator and one-time president of the Society. The award carries a $2000 stipend. Its purpose is early recognition and encouragement of young teachers, under age 35, of metallurgy and allied sciences.

Professor Paxton is a native of England. He received his BS and MS degrees from University of Manchester and his PhD from University of Birmingham. In 1949–50 he served as an ECA Fellow at Carnegie Institute of Technology and from 1950–53 as a Research Fellow at University of Birmingham. He returned to Carnegie Tech in 1953 as assistant professor of metallurgical engineering and research metallurgical engineer in the Metals Research Laboratory. In 1958 he was made an associate professor of metallurgical engineering. He is active in Pittsburgh Chapter, ASM.

♦

NATIONAL DIE CASTING EXPOSITION AND CONGRESS ACCLAIMED SUCCESS

The First National Die Casting Exposition & Congress, which ended on Friday, November 11 following a four-day showing at the Detroit Artillery Armory, has been acclaimed a success by results of a survey of the more than eighty exhibitors and by top officials of the Society of Die Casting Engineers which sponsored the affair.

A last-minute total of registrations showed that approximately 4000 persons had attended the exposition. More than 500 persons registered for the technical congress which was held in a single session in the Armory on the morning and afternoon of each day of the exposition. A minimum of 350 attended each session. Thirty-one papers were presented at the congress.

The Exposition Banquet, which was held on Thursday evening, November 10 at the Veterans Memorial Building in Detroit, attracted nearly 500 who heard Joseph G. Rayniak, vice chairman of the board and manufacturing research director of Outboard Marine Corporation address the banquet and receive the first SDCE Achievement Award for outstanding contributions in the field of die casting.

According to John L. MacLaren, chairman of the exposition and congress, the success of the affair points the way for the Society of Die Casting Engineers to undertake a planned, continuing program of sponsoring expositions and congresses to further disseminate vital technical information in the rapidly growing die casting field. The society's board of directors is already studying such plans, he said; but have not as yet made a definite decision as to when and where the next exposition will be held. Detroit has proven itself again to be one of the top cities in the United States for industrial shows, Mr. MacLaren stated.

Many foreign visitors from Europe, The United Kingdom, South America and Japan attended.

♦

COMPARISON CENTER PLANNED FOR METAL SHOW

Expanded educational emphasis on metal-working's basic materials and processes will distinguish the 1961 Detroit Metal Show, October 23–27, 1961, in the Motor City's spectacular new Cobo Hall.

An ASM Materials Comparison Center will be the educational focal point of the Detroit Metal Show. Designed as a complete and coordinated display for engineers, executives, production and purchasing men, it will include for effective comparison the materials, components and processes of a great industry.

The new Materials Comparison Center will be a "3-dimensional index" to the Metal Show. Every material and component displayed in the central plaza of Cobo Hall will carry its manufacturer's name. Every process and method of fabrication and testing will be identified as to source. Each will carry one of the product classification symbols originated by ASM at the 1960 event, together with location of the firm's exhibit at the Metal Show.

American Society for Metals will return its exposition to Detroit for the first time since 1951, with the completion of the vast Cobo Hall facility. This year, due to the size of the hall, technical sessions of the National Metal Congress can be held in the same building as the exhibits.

♦

ASM CHARTERS 115th CHAPTER

Chartering of Central Ontario Chapter, American Society for Metals, was announced November 14 by Allan Ray Putnam. It is the 115th Chapter of the 42-year-old Society.

The new Chapter, according to Putnam, will serve metalworking industry, science, education and research in an area centering upon Kitchener, London and Woodstock, Ontario. It is the Society's 13th Canadian Chapter.

American Society for Metals now numbers 32,000 technical management members in 115 Chapters and 19 student groups throughout the United States and Canada.

♦

MANUFACTURING CHEMISTS IN MIDYEAR MEETING

More than 1000 representatives of chemical manufacturing concerns gathered in New York on November 22 to participate in and attend the 10th Semi-Annual Meeting and Midyear Conference of the Manufacturing Chemists' Association, Inc.

Accentuating the role of the chemical industry in the space age, the meeting featured an address by Dr. Vannevar Bush, renowned scientist and chairman of the board of Merck and Co., Inc., on "Business Management—A Profession," at the closing banquet.

In addition to Dr. Bush, the chemical industry executives heard talks by David H. Dawson, vice president of E. I. du Pont de Nemours & Co., Inc., and General John E. Hull, USA (Ret.), president of the Association.

The seven panel discussions held throughout the one-day meeting covered such diverse subjects as the "Professional Attitude of Chemists and Chemical Engineers" and "Space Chemicals—New Frontiers in the Chemical Industry."

Another of the panels featured a discussion by three industry experts in the field of reactive metals and their relationship to nuclear energy. Other sessions will cover current industry problems in such fields as product liability, process equipment standardization and chemical indus-

try patents, with particular emphasis on the European Common Market and Foreign licensing.

The Manufacturing Chemists' Association represents approximately 90 per cent of the chemical producing capacity in the US and has a membership of 186 US and Canadian members.

♦

TWO HONORED BY ASME AT ANNUAL MEETING

Two of the highest honors in engineering were presented in New York on December 1 at the Winter Annual Meeting of The American Society of Mechanical Engineers.

Henry T. Heald, president of the Ford Foundation, became an Honorary Member of the society and Professor Carl R. Soderberg was awarded the ASME Medal. The presentations were made during the Society's banquet at the Statler-Hilton Hotel.

Honorary Membership, oldest award the society bestows, is given for effective and faithful service rendered to the society, to the engineering profession or to the public.

The ASME Medal is awarded for distinguished service in engineering and science.

Henry T. Heald became president of the Ford Foundation in 1956. For the preceding twenty-nine years, he had made his career in American higher education, serving as president of the Armour Institute of Technology, Illinois Institute of Technology and chancellor and president of New York University. He had been instrumental in bringing about the consolidation of Armour Institute of Technology and Lewis Institute to form the Illinois Institute of Technology.

Besides his teaching activities, Mr. Heald has also been active in civic and industrial affairs.

A graduate of Washington State College, he also holds a Master's degree in civil engineering from the University of Illinois, 14 honorary degrees and a number of other awards.

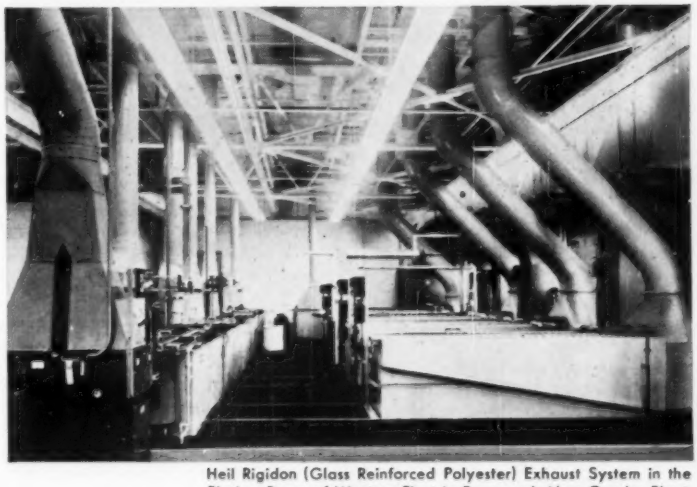
C. R. Soderberg joined the Massachusetts Institute of Technology staff in 1938 as professor of applied mechanics. He became, successively, professor of mechanical engineering, head of the department, dean of the school of engineering and institute professor.

Dr. Soderberg holds many other awards, including Knighthood in the Order of the North Star of Sweden, the country in which he was born.

He is a Fellow of ASME and a member of several other professional societies and the author of numerous technical articles.

HEIL of Cleveland

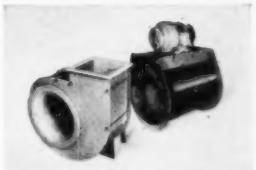
PLASTIC VENTILATING SYSTEM at *Western Electric* plant



Heil Rigidon (Glass Reinforced Polyester) Exhaust System in the Plating Room of Western Electric Company's New Omaha Plant.

features attractive appearance, high strength, long life, easy installation and complete corrosion resistance

Western Electric Engineers wrote the specifications. The ventilating system for their plating room must look as modern and attractive as all other parts of their new plant. The system must positively resist exposure to fumes and the splash of acids and alkalies. It must be sturdy and rigid; and combine long life, low maintenance, be easy to install or re-arrange, and low in first cost. The Heil Rigidon system pictured above met all these requirements.



Heil Centrifugal and Axial Rigidon Reinforced Plastic Fans.

In your plant also, Heil service-proved plastic ventilating equipment will definitely cut the costs of handling corrosive fumes. Complete line, including collecting hoods, ducts, fans, stacks and fume scrubbers in Rigidon (reinforced plastic) or Rigivin (rigid vinyl) construction. Wide range of standard sizes speeds delivery and minimizes engineering costs.

Heil Fume Scrubber and Rigidon Duct Work.

Write today for Bulletin No. B-500. It lists chemical resistance data and specifications of standard sizes of equipment that can be installed by your own maintenance men or local contractor.

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INDUSTRY NEWS

ALERT SUPPLY NAMED WEST COAST DISTRIBUTOR BY TECHNIC

Alert Supply Company, 2041 South Davie Ave., Los Angeles has been appointed West Coast distributor of the precious metal plating solutions of Technic, Inc., Providence, R. I.

Announcement of the distributorship was made jointly by Frank K. Smith, president of Technic, and A. E. Perkins, president of Alert.

The new arrangement makes Technic solutions, and the facilities of the firm's research and development organization, available to West Coast manufacturers for the first time, Mr. Smith said. He pointed out that precious metal plating has wide application in the electronics industry, which has a large Pacific Coast concentration.

♦

WYANDOTTE APPOINTS STEVENS IN NEW ENGLAND

Wyandotte Chemicals Corporation, J. B. Ford Division has announced the appointment of Frederic B. Stevens, Incorporated, as a distributor for Wyandotte metal cleaning and finishing products in the New England area. Stevens already is handling the Wyandotte line in the midwest.

Frederic B. Stevens, Incorporated, 78 year old Detroit firm whose main office is located at 1800 18th Street, will maintain a complete stock of Wyandotte metal cleaning and finishing products for the New England area in its new warehouse facilities in Wallingford, Conn.

NOBLE IN ENGLAND TO DISTRIBUTE IONIC EQUIPMENT

The appointment of H. R. Noble, Ltd., 236 North Circular Road, Palmers Green, N. 13, London, England as exclusive Great Britain distributor for Ionic Electrostatic Corporation, has been announced by John Sedlacsik Jr., president.

H. R. Noble Ltd. will handle the entire line of Ionic electrostatic coating equipment and will maintain a stock of Ionic equipment as well as demonstration facilities.

♦

ELECTROSHAPING PROCESS DEVELOPED AT BATTELLE

An electrolytic machining process that can shape parts from the toughest alloys in as little as one-tenth the time of conventional machine tools has been developed by Battelle Memorial Institute in research supported by the Steel Improvement and Forge Company, of Cleveland.

Metal is removed without arcs, sparks, or high temperatures by passing direct current between the workpiece and an electrolyte. The current removes electrons from the workpiece, converting the surface atoms into positively charged ions that dissolve into the electrolyte. This process is unique in that its effectiveness is not dependent on the hardness of the metal and, thus, offers a solution to the problem of machining the harder, higher-strength metals.

To produce a part, a rough forging or piece of metal stock (anode) is placed between shaped electrodes (cathode) and electrolyte is pumped under pressure into the space between the electrodes and the workpiece. As the electric current dissolves the workpiece to the desired shape, the electrodes are moved in simultaneously.

The electrolytic unit has machined rough forged jet turbine blades to 0.003-in. tolerances in 5 to 10 minutes—an operation which took from 1 to 2 hours to perform by grinding. In addition to shaping parts, other types of units can be used to sink die cavities in 50 minutes which previously required 7 to 10 hours of machining time. They also can drill round and irregularly shaped holes in alloys that cannot be penetrated by conventional drills. For some applications the process's big advantage is not the time saved but the absence of mechanical damage to the surface of the workpiece.

Because there is no tool pressure on the workpiece, very thin sections can be shaped without deformation and lightweight machines and clamping systems can be used.

The development of the electrolytic machining process is the result of over two-and-a-half years of work by a Battelle research team which included Dr. Charles L. Faust, chief of electrochemical research at the Institute; Dr. John A. Gurklis and John E. Clifford.

According to Dr. Faust, the Battelle-developed process differs from others which use the electrolytic metal removal principle in that: 1) it can produce complete parts in addition to sinking cavities, 2) it uses no rotating cutting wheels, 3) power is supplied through a simple rectifier instead of complex electronic circuits.

♦

INDUSTRIAL FINISHES CONVENTION TO BE HELD IN LONDON

The world-wide interest that has been aroused by the announcement that the First International Industrial Finishes Exhibition will be held at Earls Court, London, between May 8 and 11, 1961, has resulted in a large proportion of the available floor space being already firmly booked by a number of leading firms specializing in metal pretreatment, paint manufacture, paint shop plant, electroplating equipment, supplies, and "outwork" services, anodizing, marking processes, metal spraying, plastic coated sheet and coatings and numerous other supplies and processes.

The organizers (Scientific Surveys Ltd., Exhibition Division, 97 Old Brompton

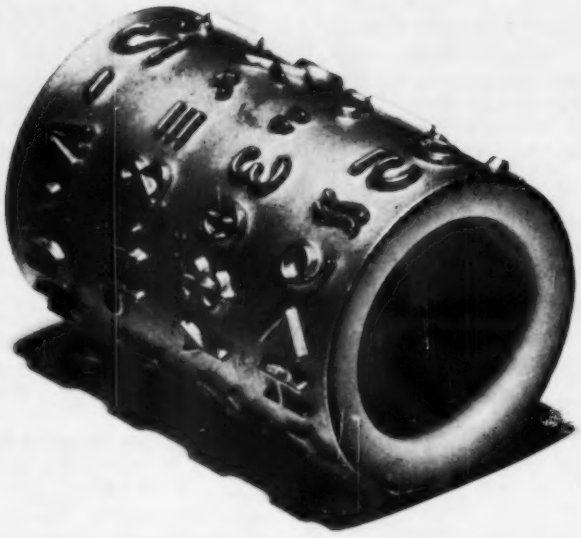
VAN WATERS & ROGERS, INC., APPOINTED ALERT SUPPLY AND H-VW-M DISTRIBUTOR

Alert Supply Company has appointed Van Waters & Rogers, Inc., with offices and warehouses at Seattle and Spokane, Washington; Portland, Oregon, and Boise, Idaho, as its distributor in the Washington-Oregon-Western Idaho territory. The appointment became effective October 1.

"Van Waters & Rogers' background in chemical and other sales makes them ideally suited to handle the wide line of Alert and Hanson-Van Winkle-Munning Company metal finishing supplies and equipment," said A. E. Perkins, president of Alert Supply Company.

Alert is a wholly-owned subsidiary of Hanson-Van Winkle-Munning Company of Matawan, New Jersey.

precise-production **ELECTROFORMING**



BARRETT SULFAMATE NICKEL has engineered reliability for:

- exceptional low stress
- high speed deposition
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- dimensional stability to thermal cycling
- less nodular growth
- superior throwing power
- excellent grain structure
- high chemical purity
- nickel to metal, glass, or ceramic bonding

BARRETT SULFAMATE NICKEL — a ready to operate process for heavy electrodeposition of nickel having exceptionally low tensile stress

Request Bulletin SN

Barrett Sulfamate Nickel on electroform mandrel indicating superior throwing power. Photo 500 x

BARRETT
chemical products company, inc. Shelton • Connecticut

Road, London, SW 7, England) now announce that plans are made to hold an Industrial Finishes Convention at the same time as the exhibition. It is proposed that the convention will be held in the special meeting rooms at Earls Court, and will consist of two sessions daily.

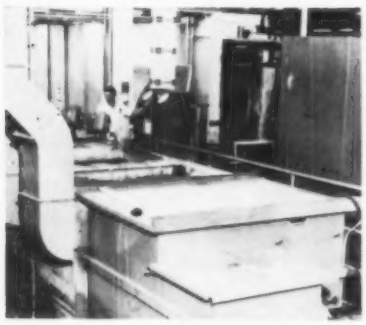
♦

DOUGLAS INSTALLS HARD COAT ANODIZING SYSTEM

Douglas Aircraft Company has announced that it has recently installed one of the largest hard coat anodizing installations in the country at the Army-owned, Douglas-operated Charlotte, North Carolina plant. The Charlotte plant, occupying 77 acres, is devoted primarily to the manufacture of the Nike Hercules missile, the Army's primary ground/air antiaircraft weapon.

The heart of the hard anodizing installation, consisting of five process and rinse tanks, is a constant current, constant voltage control, automatically controlled 100-v, 1000-amp rectifier, designed and built by Hanson-Van Winkle-Munning Company, Matawan, N. J.

An example of the work which Douglas successfully processes in this installation is a hydraulic cylinder for the Nike Hercules. Because the missile may be stored for many years before use, and because its components must be periodically tested during storage, the interior of the cylinder must, in addition to presenting a hard wear surface, also be corrosion and crack resistant.



The Douglas anodizing cycle takes approximately 75 minutes to complete. It is necessary to provide a constant current of 25 amp/sq ft to the hydraulic cylinder for suitable anodizing. At the beginning of this cycle, the voltage requirements to maintain this amperage stand at between 10 and 20 volts. At the end of the cycle, 85–90 volts are necessary to maintain the 25-amp current density.

The rectifier control panel includes a recording ammeter and voltmeter to help Douglas record changes in the process and thus achieve maximum control and surface uniformity. Several safety features were included to enable the unit to protect itself against internal and external damage.

ENTHONE APPOINTS LICENSEE IN MEXICO

Butcher-Udylite de Mexico, S.A. de C. V., (BUMSA), has been licensed by Enthone, Inc. of New Haven, Connecticut, subsidiary of American Smelting and Refining Company, to manufacture, sell, and service the complete line of Enthone products in Mexico. BUMSA is a subsidiary of the L. H. Butcher Company of Los Angeles, California, also an Enthone licensee.

BUMSA manufactures plating equipment and specialty chemicals for the Mexican plating and metal finishing industry. It is headquartered at Calle Norte 45 No. 870, Industrial Vallejo, Mexico City. Through local manufacture, BUMSA will be able to provide immediate shipment of any Enthone product at reasonable prices to Mexican metal finishers.

Enthone chemicals are also manufactured in England, France, Italy, Sweden, West Germany, Brazil and Canada.

♦

TECHNIC INTRODUCES RECOVERY UNIT AND MAKES AVAILABLE RESEARCH CENTER

Technic, Inc., of Providence, R. I., which makes gold, platinum, rhodium, and palladium plating solutions, announced on October 19 two developments in conjunction with an open house and dedication of its new plant in Cranston, a suburb of Providence.

Introduced by Frank K. Smith, president, were: (1) The Gold Saver, the first commercial unit for regaining gold which up to now has been lost by electroplaters. A plater who has been testing the unit will have recovered his costs within three months of operation, Mr. Smith reported. (2) The Technic Precious Metals Plating Center, a pilot plant which permits research and development under laboratory

PLATING MAGAZINE TECHNICAL ARTICLE REPRINTS AVAILABLE

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The Technic Precious Metals Plating Research Center. The pilot plant production line (above) consists of a series of seven-gallon tanks for all cleaning, activating, and plating procedures and solutions.

controlled conditions. The unique facility is available without charge for use by companies with plating problems or projects.

Explaining development of the Gold Saver, Smith said that until now, between 4 and 10 per cent of all gold used in electroplating has been lost during the final rinsing of the plated objects. The total loss may run to millions of dollars annually.

Heart of the gold recovery system is a column of special resin which traps the gold before rinsing. A pump also is part of the unit.

Industry practice has been to conserve the original gold solution by dipping the plated item into a tank of water immediately after plating. This solution eventually develops a concentration of gold which is re-used.

Next step has been a rinse in running water, even though, according to Mr. Smith, the plated item still carries some gold solution, although extremely diluted.

The Gold Saver is to precede the running water rinse, Mr. Smith said. The unit is installed in a tank containing water, and the plated item is dipped here before being rinsed in running water.

The pump constantly circulates the tank's water and diluted gold solution through the special resin, which recovers the gold, Mr. Smith explained.

Another of the company's "firsts"—the Precious Metals Plating Research Center—offers industry a means of conducting all cleaning, activating, and plating procedures under production conditions, but with laboratory control.

The pilot plant is a series of seven-gallon tanks with accurate control on temperature, voltage, amperage, time, and plating solutions. Each tank is jacketed with insulation to provide even heat throughout, and each has an independent source of controlled electrical power.

NEED HEAVY BUILDUP FOR RESIZING, ELECTROPLATING, ELECTROFORMING OR OTHER FUNCTIONAL USES? EXPERTS AND USERS AGREE: NICKEL SULFAMATE IS THE MOST SUITABLE BATH FOR FUNCTIONAL NICKEL PLATING.

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MECHANICAL PROPERTIES OF DEPOSITS ARE CONTROLLABLE

CONCENTRATE CHLORIDE FREE

NO DRY CHEMICALS TO DISSOLVE

EASY TO CONTROL

NICKEL SULFAMATE

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H-VW-M

Progress in metalfinishing through advanced processes • equipment

Hanson-Van Winkle-Munning Company, Matawan, New Jersey • Offices in Principal Cities
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2698

TRUE BRITE
Practical Products

TRUE BRITE Nickel Brightener
the original high performance barrel nickel brightener. Still the standard.

BRASS MAINTENANCE Solutions
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OXYPHEN pH Papers
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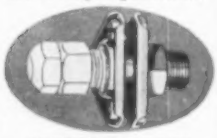
PERFORMANCE
PROVED
SPRAY NOZZLES TO LOWER YOUR COSTS IN

● Complete choice of types, capacities and spray characteristics for every operation.



ADJUSTABLE JOINTS
—for quickly setting each spray to fit the work.

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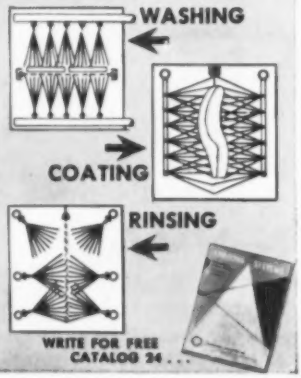

WRITE FOR FREE CATALOG 24 . . .

INDUSTRY NEWS BRIEFS

MINNESOTA MINING TO BUILD AUSTRALIAN COATED ABRASIVES PLANT

Plans for the construction of a coated abrasives plant in Australia were announced recently by Minnesota Mining & Manufacturing Co.

The 3M Company revealed that its Australian subsidiary will soon begin construction on the new plant, to be located at the site of the present 3M Australia plant at St. Mary's, New South Wales. It is expected the plant, which will have about 40,000 square feet of floor space will be in production early in 1962.

The present production facilities of 3M Australia occupy nearly 90,000 square feet and are devoted to manufacturing and converting operations for a wide variety of 3M products. The new abrasives plant reflects the continuing sales growth of 3M's manufacturing subsidiaries abroad.

♦

NEW DIAMOND ALKALI PLANT TO BE COMPLETED LATE THIS YEAR

The multi-million dollar Diamond Alkali Company acetylene plant to be constructed at this chemical producer's Deer Park, Texas plant, is expected to be completed late in 1961, Raymond F. Evans, chairman and president has announced. The plant will supply all acetylene required for the manufacture of Diamond's polyvinyl chloride plastics at the Deer Park installation.

The new acetylene plant will be based on a process developed by Montecatini, Societa Generale per l'Industria Mineraria e Chemica, the leading Italian chemical company with headquarters in Milan. Montecatini has licensed major chemical patents and processes throughout the world.

♦

HOLLAND OFFERS PLANT LAYOUT SERVICE

A free technical layout service to be offered to those interested in new electroplating plant installations or additions to existing plants has been announced by J. Holland & Sons, Inc.

Upon request, complete layouts will be submitted indicating the location of tanks, rectifying equipment, exhaust systems, waste disposal facilities, rack design and material handling equipment. No charge will be made for the service.

♦

EUROPEAN CORROSION REPORT AVAILABLE

The Annual Report for 1959 of the European Federation of Corrosion is now available (duplicated typescript, 143 pages). It has been edited, as in previous years, by the Frankfurt Office of the General Secretariat of the European Federation of Corrosion.

The European Federation of Corrosion, which had a membership of 52 societies from 17 European countries at the end of 1959, looks back on a year of satisfactory development. Progress has been reflected particularly by the number of meetings at a European level which increases every year. These meetings attract scientists from all parts of Europe and provide the opportunity for a lively exchange of views.

Thus the Annual Report for 1959 of the European Federation of Corrosion provides specialists with information on the technical work on corrosion which has been carried out in Europe, with particulars of addresses and publications, research projects and papers read at meetings.

The report can be ordered from the General Secretariat of the European Federation of Corrosion, Buro Frankfurt (Main), Postfach 7746.

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INDICATE A 134 ➤

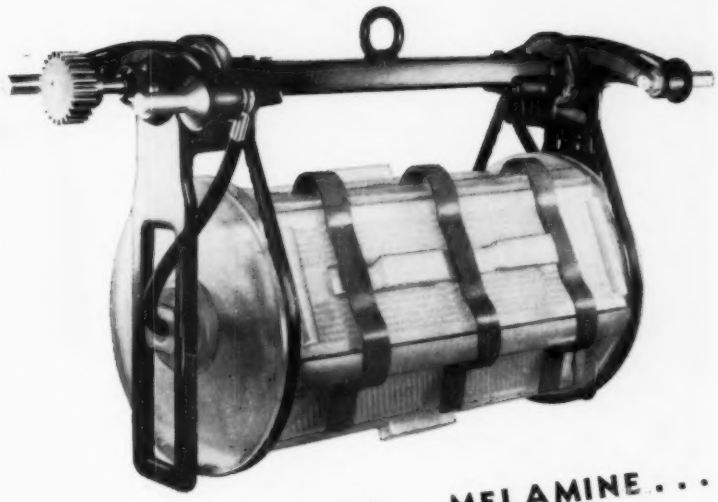
The NEW STUTZ Plating Barrels

Low headroom design
New materials

Stutz complete cycle assembly for operation in tanks with driving mechanism located externally. Lifting and lowering of unit reduced to a minimum. Cylinder is totally submerged in operation. Belt drive is positive timing design and belts can be changed if necessary in seconds without tools. Saddle horns are located on 15" centers. Cathode contactors dangler type standard, other types available. Cylinder hangers are cast steel protected with special hard rubber or fused vinyl chloride.

Cylinders can be supplied in special sizes, partitions if necessary and special cathode contactors as required.

Barrel assembly units are made to fit all makes of tanks.



. . . . . PLEXIGLAS · POLYPROPYLENE · TEMPRON · MELAMINE . . . . .

Cylinder rotation in this design is provided by motor drive mounted directly in super structure bridge member. Total weight and overall height has been greatly reduced. Handling therefore is fast and smooth. Cylinder transported from one operation to the next under continuous rotation. In this manner solution dragout is reduced to a minimum. Rinsing time following alkali cleaning, acid pickling, etc., is greatly reduced. Overall dimensions of tanks is lessened by the elimination of motor drive platform. Electric service 440, 220, or 115 volt with grounded cable and Hubble-lock heavy duty safety connector.

Sizes 12" to 18" inside diameter—24" to 42" long—perforations 3/32" standard. All other sizes available.

Tanks in single and multiple—Power equipment — dryers — filters — heat exchangers -- chemicals — anodes — ventilation, etc.

Barrel assembly units are made to fit all makes of tanks.

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The Stutz Portable Barrel is made in 3 standard sizes with cylinders having inside dimensions of 6"x12", 8"x18" and 10"x20" I.D. Smaller upon application. Standard openings are 3/32". Smaller or larger openings can be furnished as required.

- Baskets in perforated metals or wire mesh.
- Load/Unload Stand for convenient and fast handling of work load.

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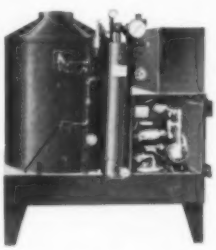

Easy to Install and Care For. Houston Electro-Plating made their own installation—so can you. The 15 bhp model shown is a space saver, too, requiring only 30" x 48" floor area. Coil-type construction does away with costly re-tubing, and shutdowns for official inspection.

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Company_____

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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
SEL-REX CORPORATION
Nutley, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

2,950,215, 8/16/60—STRIP COATING—J. Slater and E. Platt, assignors to Armico Steel Corp., Middletown, Ohio.

An apparatus for hot dipping metallic strip is claimed.

13 claims, figure.

♦

2,950,233, 8/23/60—HARD SURFACES—M. Steinberg and R. McAllen, assignors to Horizons, Inc., Princeton, N. J.

Surfaces can be provided with a titanium carbide coating by making said surface the cathode in a fused salt bath, passing a current through the bath to deposit titanium, then heating to 840C to thermally diffuse the carbon from the steel into the titanium.

1 claim.

♦

2,950,234, 8/23/60—CHROMIUM PLATING—George Dubpernell and A. Johnson, assignors to Metal & Thermal Corp., Woodbridge Twp., N. J.

The CrO_3 catalyst ration of a chromium plating solution can be controlled by the presence of undissolved potassium dechromate and potassium silicofluoride and strontium sulfate.

13 claims, figure.

♦

2,950,235, 8/23/60—ACID COPPER BATH—W. Struss and W. Willmund, assignors to Dehydag, Dusseldorf, Germany.

High quality copper deposits are claimed from an acid bath containing compounds of the formula

$$Z_n (R - SO_3H)$$

Where R is a radical selected from the group consisting of lower aliphatic saturated hydrocarbon and aromatic radicals, Z is a azido group and $_n$ is a whole number of at least one. This material is added in amount sufficient to prevent sludge formation.

8 claims.

♦

2,950,725, 8/30/60—ULTRASONIC CLEANING—S. Jacke, *et al*, assignors to Detrex Chemical Industries, Detroit, Mich.

An apparatus for ultrasonic cleaning whereby the waves are focused is described.

5 claims, figure.

♦

2,950,991, 8/30/60—COATING WITH ALUMINUM—H. Seymour, assignor to American Chain & Cable Co., New York, N. Y.

After dipping the ferrous article in molten aluminum withdraw and cause to have impinged upon the article a mist of liquid coolant.

10 claims, figure.

♦

2,951,018, 8/30/60—ELECTRODEPOSITION OF NEPTUNIUM—G. Seaborg and A. Wahl, assignors to U. S. A. (AEC).

Neptunium can be deposited from an absolute alcohol solu-

tion containing neptunium and lanthanum nitrates at about 50 volts and 1.8–4.7 milliamperes per square decimeter.

1 claim, figure.

♦

2,951,019, 8/30/60—MAKING PLATED INTAGLIO PRINTED FORM—H. Dalton, Jenkintown, Pa.

The method of making a plated intaglio surface printing form, which comprises covering a metal base with a sheath of a film-forming resinous plastic which is normally non-porous and contains powdered carbon and is readily strippable from the metal base, electrically perforating said sheath in minute discrete areas by electric signals applied thereto and controlled by corresponding elemental areas of the subject matter to be printed to form directly a perforated record of the subject matter, plating said base through said perforations to form raised plated dots corresponding to the perforations in said sheath, and then stripping said sheath from said base.

6 claims.

♦

2,951,020, 8/30/60—PLATING POLONIUM—R. Wehrmann, assignor to U. S. A. (AEC).

Polonium can be plated from an HF (1 N) solution at 1.2 milliamperes per square centimeter.

♦

2,951,021, 8/30/60—PRODUCTION OF TITANIUM—W. Di Pietro, assignor to National Research Corp., Cambridge, Mass.

A method of producing titanium by electrolysis of molten halides is described.

6 claims, figure.

♦

2,951,025, 8/30/60—APPARATUS FOR ANODIZING ALUMINUM—N. Mostovych and A. Cybriwsky, assignors to Reynolds Metals Co., Richmond, Va.

An apparatus utilizing a polyphase alternating power supply for 3 tanks is described.

5 claims, figure.

♦

2,951,768, 9/6/60—REMOVAL OF ZINC COATING—M. Brash, *et al.*, 762 Granite St., Braintree, Mass.

To weld zinc coated steel, treat the surface to be welded with 15–20 per cent HCl plus cupric chloride.

2 claims.

♦

2,951,793, 9/6/60—ELECTROLYSIS OF THORIUM AND URANIUM—W. Hansen, assignor to U. S. A. (AEC).

Deposit the thorium or uranium on a Zn, Cd, Sn, Pb, Sb or Bi cathode in molten condition using a fused salt electrolyte.

13 claims.

♦

2,951,794, 9/6/60—PURE CHROMIUM—R. Dean, and F. McCawley, assignors to Chicago Development Corp., Riverdale, Md.

The method of producing a non-porous chromium plate on a steel cathode electrochemically protective to said steel which consists in passing a direct current from a comminuted crude chromium anode to said steel cathode in an electrolytic cell having an electrolyte consisting of at least one alkalinous chloride in which is dissolved from 1–10 per cent chromium as chloride having an average valence of 2.05–2.2 and about 0.1 per cent alkalinous metal as determined by hydrogen evolution in acidified ferric chloride solution, at a temperature of about 800C and a current density on the original cathode surface of 10–500 asf and on the anode from 0.01–50 asf until a plate on the cathode of at least one mil thickness is formed, then continuing the electrolysis to produce a layer of salt containing fine chromium crystals up to 10 mils thick surmounts the plate, then cooling the cathode and adherent deposit in an inert atmosphere and removing the layer of salt and fine crystals by scrubbing with water.

See also 2,951,795 which in 6 claims discusses the production of Ti, Zr and Cr from fused salts.

1 claim.

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2,952,528, 9/13/60—TRANSISTOR ETCHING—B. Cornelison, assignor to Texas Instrument Incorporated, Dallas, Texas.

Method of etching comprising introducing an article to be etched into an etching medium supported on an immiscible inert medium, at the adjacent interface of the two media, supporting said article in said etching medium, releasing said article responsive to a predetermined reduction in size and transferring said article through said interface to said inert medium to stop further etching action.

4 claims, figure.

♦

2,952,568, 9/13/60—HOT DIP GALVANIZING—W. Diehl and H. Bell, assignors to Wheeling Steel Corp., Wheeling, W. Va.

A method for hot dip galvanizing is claimed.

1 claim, figure.

♦

2,952,572, 9/13/60—ELECTROLYTE—T. Johnson, assignor to Remington Arms Co., Bridgeport, Conn.

The electrolyte for primary cells is described as consisting essentially of at least one material of the group consisting of phosphates of K, Na and NH_4.

8 claims.

♦

2,952,590, 9/13/60—CHROMIUM PLATING—J. Stareck, *et al.*, assignors to Metal & Thermit Corp., Woodbridge, N. J.

A process is claimed for depositing bright crack-free chromium from a bath containing less than 0.05 g/l of chloride ion and a catalyst of sulfate ions and fluoaluminate, fluozirconate or fluotitinate.

10 claims, figure.

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2,952,904, 9/20/60—PROTECTIVE METAL COATINGS FOR MOLYBDENUM—E. Hann, assignor to Westinghouse Electric Corp., East Pittsburgh, Pa.

A member comprising a molybdenum body and a well bonded imperforate coating applied to the entire surface of the body, the coating having good resistance to oxidation at elevated temperatures and good resistance to impact and shock so as not to expose the molybdenum body under normally expected service conditions, said coating comprising at least one continuous layer of an oxidation-resistant metal selected from the group consisting of chromium and nickel-chromium alloys sandwiched between at least two continuous layers of a fused brazing alloy comprising, by weight, from 11 per cent to 25 per cent chromium, from 2 per cent to 12 per cent silicon, up to 8 per cent iron, up to 3½ per cent boron, and the balance being substantially all nickel with incidental impurities, said layers of fused brazing alloy bonded together the layers to each other and to the molybdenum body, the said coating having a wall thickness of the order of from 5 mils to 10 mils.

6 claims, figure.

♦

2,953,472, 9/20/60—COATING METALLIC ARTICLES WITH METAL—J. Nachtman and J. Bjorksten, 323 W. Gorham St., Madison, Wis.

Preheat the metal article to 300F then impinge a flame of burning metal carbonyl thereon.

8 claims, figure.

♦

2,953,473, 9/20/60—COATING WITH ALUMINUM—D. Mitchell, assignor to American Mollerzing Corp., Beverley Hills, Calif.

A process for continuously coating base metals with a molten coating metal selected from the group consisting of aluminum and aluminum alloys, wherein said molten coating metal overlies at least a portion of a heavier molten salt bath, which comprises the steps of: passing said base metal through a first zone only of said molten salt bath, the first zone being maintained at a higher temperature than a zone of said salt bath section; causing circulation of salt from the first hotter zone downwardly to the lower colder zone and thence upwardly to create a flow pattern in the salt bath; withdrawing said base metal through said molten coating metal which overlies at least a portion of the surface of said salt bath to be thereby coated, those oxides and impurities present in an amount above the saturation point of the lower zone being precipitated within said lower zone of the salt bath remote from the path of said base metal.

10 claims, figure.

♦

2,953,512, 9/20/60—PLATING RACK—G. Villette, 12 Blvd. Marechal Foch, Grenoble, France.

A plating rack assembly is described.

2 claims, figure.

♦

2,954,309, 9/27/60—COATING FERROUS METALS—C. Swalm and S. Spring, assignors to Pennsalt Chemicals Corp., Philadelphia, Pa.

A phosphating composition for iron, zinc and their alloys consists of a phosphate solution containing pentavalent arsenic, trivalent arsenic or trivalent chromium.

9 claims.

♦

2,954,331, 9/27/60—COPPER PLATING BATH—C. Abbott, assignor to Dayton Bright Copper Co., Trotwood, Ohio.

The addition of 5 to 50 mg/l of a compound selected from pyridine, thiourea allythiourea and acetylthiourea along with polyacrylamid (0.005 to 0.5 g/l) to an acid copper bath yields bright deposits.

14 claims.

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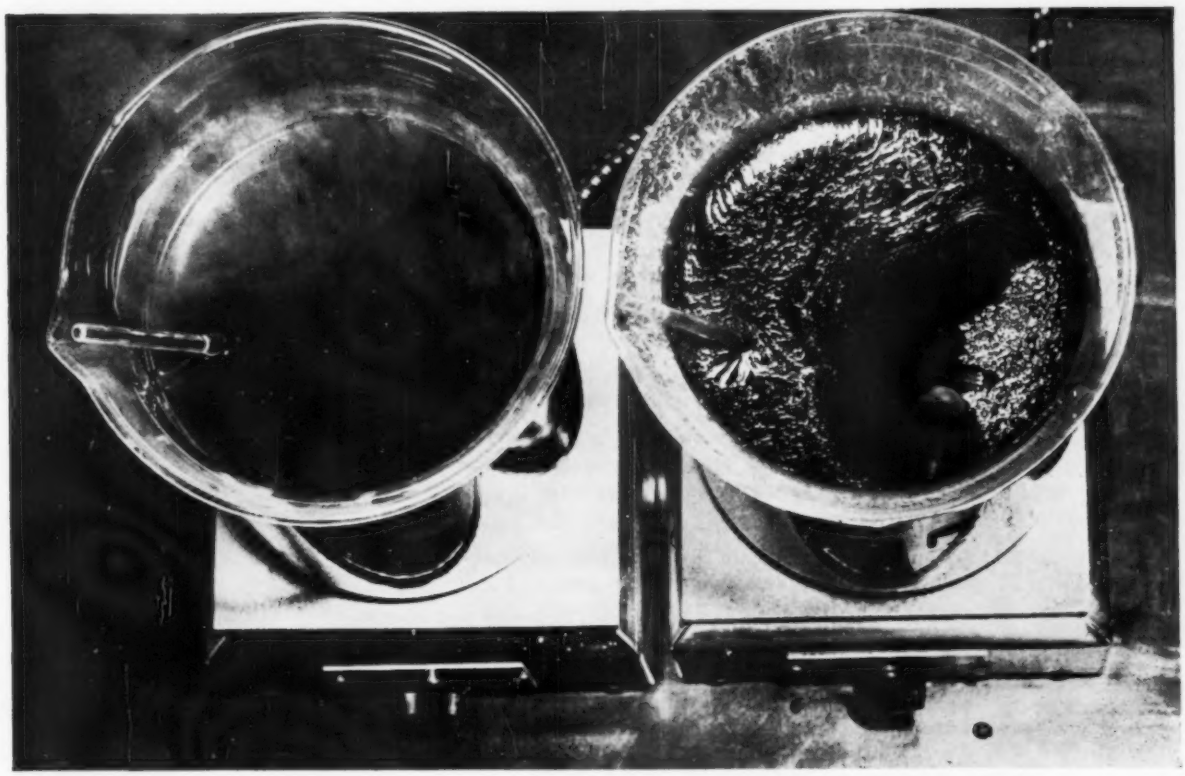
From Wyandotte research comes a powerful new heavy-duty vat cleaner that won't form scum. This lab test shows the difference:



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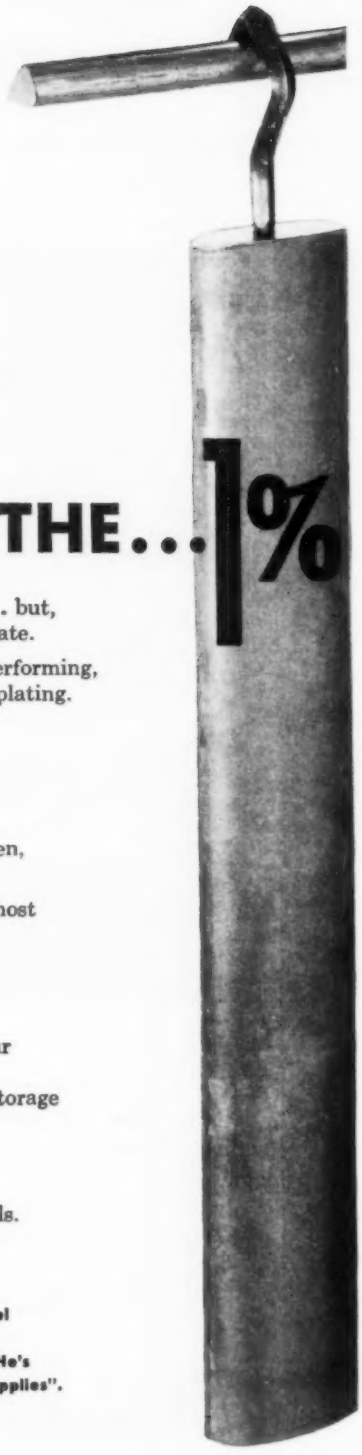

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ARTICLE REFERENCES

(*Continued from page 32*)

6. ELECTROFORMING

COMPOSITE MATERIALS FOR THERMAL PROTECTION.
E. Scala.
Metals Review, November 1960, pp. 4–9.

The following is a metallurgical abstract taken from The Journal of the Institute of Metals, July 1960, p. 746:

NICKEL

Gas in Electrodeposited Nickel. Kiyokado Nishihara, Seizo Tsuda, and Yoshitaka Matsumura (Suiyokwai-Shi, 1959, 14, (1), 39–42)—(In Japanese). The effects of electrolysis conditions on the amount of gas contained in Ni electrodeposited from acid $NiSO_4$ soln. were investigated. The gas was found to consist chiefly of H, and the amount to decrease with thickness of the deposit or with decrease in pH of the electrolyte. The amount of gas in the Ni deposit is a min. at 50C. The gas content is decreased by the addn. of p-toluene sulphonamide to the electrolyte.

ELECTROPOLISHING—August 1960 p. 801

Polarization and Polishing Studies on Copper in a Hull Cell. Indra Sanghi and Vr. Ramanathan (Proc. Indian Acad. Sci., 1959, (A), 49, (5), 281–292).

THEORETICAL

Overvoltage and Diffusion (of Hydrogen) Through Iron and Palladium. J. N. Andrews and A. R. Ubbelohde (Proc. Roy. Soc., 1959, (A), 253, (1272), 6–15).

ALUMINUM—October 1960, p. 151, 153–164

The Use of Malonic Acid as an Anodizing Electrolyte. J. M. Kape (Metallurgia, 1959, **60**, (361) pp. 181–191)—A wide variety of alloys coatings were produced, having properties notably superior to those produced by conventional anodizing methods. K. discusses the various anodic films which can be obtained from a 12.5 per cent wt/vol. electrolyte with different c.d., temp., and voltages. The coatings formed are of a deep yellow or sepia colour, can be extremely hard, corrosion- and abrasion-resistant and possess a high inherent light-fastness.

The following abstracts are from the SYMPOSIUM ON THEORETICAL PROBLEMS OF CHROMIUM PLATING, Vilna 1958, 1959, (In Russian)

The Theory of Chromium Plating. Yu. Yu. Matulis. pp. 7–38.

The Problem of Self-Regulation of Chromium Plating in Tetrachromate-Type Baths. A. N. Sysoev, N.T. Drobantseva and N.P. Yur'ev. pp. 165–175.

The Role of Sulphuric Acid in Electrodeposition of Chromium. D. N. Usachev and A. T. Vagramyan. pp. 91–101.

Cathodic Film Formed During Electrodeposition of Chromium. M. A. Shluger. pp. 121–128.

Deposition of Chromium from Electrolytes Containing Two Types of Addition Agents. M. A. Shluger. pp. 129–135.

Chromium Plating of Aluminium and Magnesium Alloys. V. I. Lainer. pp. 151–163.

Hydrogen Evolution at the Chromium Cathode. R. M. Vishomirskis and L. Kh. Derish. pp. 81–90.

Application of the Theory of Irreversible Polarographic Waves to the Study of the Mechanism of Reduction of Chromic Acid. A. V. Pamfilov and A. I. Lopushanskaya pp. 103–120.

The Effect of the Cathode Material on Electro-Reduction of Chromic Acid. A. Yu. Mitskene and Yu. Yu. Matulis. pp. 39–52.

Some Phenomena Occurring During Electro-Reduction of Chromic acid. M. A. Mitskus. pp. 53–65.

Colloidal Phenomena During Interaction of Trivalent Chromium Hydroxide with Chromic Acid. Yu. Yu. Matulis and D. K. Rimdzhyute. pp. 67–80.

The Mechanism of Electrochemical Reduction of Chromate Ions with Formation of Chromium Hydroxide on the Cathode. A. I. Levin. pp. 137–149.

Corrosion Technology
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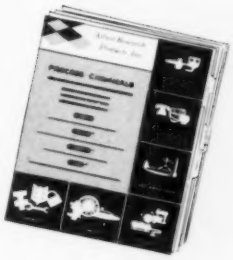

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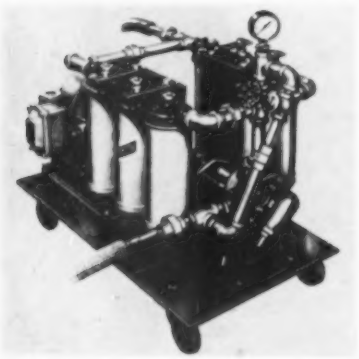
EQUIPMENT AND SUPPLIES

E—101. VACUUM METALIZING LACQUER FILTER SYSTEM—A lacquer filter system that removes particles down to one micron has recently been developed by Sethco Manufacturing Corp.

The new CCG1E series combines a self-priming gear pump, an approved explosion-proof motor steel filter chamber with cotton filter tubes, pressure gage, and



solvent resistant hose, all mounted on a corrosion resistant panel equipped with ball bearing casters for portability.

Available in capacities from 30 to 1200 gallons per hour for lacquer, these filter systems are also suitable for filtering paints, solvents, oils, and emulsion cleaners.

E—102. VIBRATORY FINISHING MACHINE—A new laboratory model finishing machine of novel vibratory type (patent applied for) has been announced by the Stevenson Company. This unit is designed especially for laboratory use and quantity production of small precision

parts. The Vibrodyne Model V-013 is adapted for deburring, radii-forming, descaling, cleaning, polishing of small parts, powdered metal gears, steel bushings; aluminum and copper parts for the electronic industry; ceramic eyelets, discs, wedges, etc.

This Model V-013 is 18 in. long, 11 in. wide, 11.5 in. high and weighs 29 lb. The 1/8 cu ft (approximately one gallon) tub capacity may be rotated to any angular position for dumping or screening.

E—103. NICKEL PLATING PROCESS—An advanced process for electroplating a coating of sulfur-free, semi-bright nickel on metal surfaces has been announced by The Udylite Corporation. The process is expected to reduce costs and improve the appearance and durability of electroplated finishes on automotive parts, appliances and other metal products.

The new process, designated N2E by Udylite, is claimed to be an important advance in the plating industry because of its extreme simplicity of operation, consistent uniformity of coating appearance, ease of control and economical use of continuous filtration with activated carbon.

The new process, covered by patents granted to The Udylite Research Corporation, a subsidiary of The Udylite Corporation, involves the simultaneous addition to the electroplating bath of two Udylite addition agents, Brightener E and Brightener 2N. From the combination comes the name of the new process, N2E.

Brightener E is effective chiefly in the low and intermediate current density ranges; Brightener 2N works primarily in the intermediate and high current density areas. Combined, they are said to promote uniformity and consistency on high and low surfaces of formed metal parts.

One advantageous feature of the new process enables electroplaters to pour the addition agents directly into the bath without first passing them through a filter. Because of their nature, appreciable errors in adding the agents to a bath will not result in serious trouble.

The process can be applied in any plating sequence in which other semi-bright nickel processes are now used. It permits the use of higher bath temperatures up to 150° for high-speed plating.

E—104. THICKNESS GAGE—A new instrument has been introduced by Twin City Testing Corp., Tonawanda, N. Y. for gaging the thicknesses of coatings on iron and steel. Identified as the Type ES Permascope, the device provides a non-destructive means of measuring thicknesses of organic and non-magnetic metal coatings (including phosphate) with the accuracy of the microscopic method, says Twin City.

A compact, portable unit measuring 5-1/4 by 8-3/4 by 5 in., a Type ES Permascope can be utilized wherever an 110 ac outlet is available. It features a small, 2-pole probe which works on the principle of a magnetic amplifier. To measure the thickness of a coating, the probe is simply applied to the surface. A closed magnetic field is created between the poles of the probe with the lines of force largely contained within the base metal. The thickness is indicated on one of the direct-reading scales of the instrument.

E—105. FILTER CARTRIDGE—Unique micronic filtering of plating solutions and many other fluids is provided by the new Micro-Wynd disposable filter cartridge. The patented Micro-Wynd manufacturing process is used, employing a separate filtering medium that is interwoven between the structural spiral winding. According to the manufacturer, the

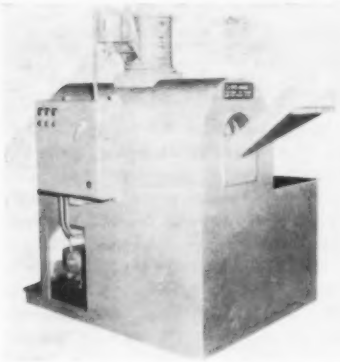
Micro-Wynd filter is able to trap progressively finer contaminant particles from outside diameter to core, maintaining a consistent flow rate with minimum risk of loading. The filter cartridge ends are wound square with the core axis enabling any number of cartridges to be assembled end-to-end in tiered arrangements without sealing devices, when inserted in a suitable filter housing.

E—106. BLACK ALUMINUM DYE—Blak Black (Patent Pool), a dye developed by Technical Processes Division of Colonial Alloys Co. to eliminate conventional jet black dyeing of anodized aluminum difficulties, is said to attain a deep hard clean jet black, free of a smutted surface in as little as 15 minutes of anodizing (180 ampere minutes), used as directed in many standard color anodizing techniques. Different aluminum alloy compositions may require slight variations in the anodizing time.

The penetration into the anodized coat is claimed to be fast and uniform, and its finished appearance is a deep jet black.

E—107. CLEANING MACHINE—Just 5 feet long and 4-½ feet wide, a drum-type cleaning machine designed specifically for low-cost volume cleaning of small parts has been introduced by Cincinnati Cleaning & Finishing Machinery Co. The machine has a variable speed drive which provides capacity ranging from 6 to 9 cubic feet of parts per hour.

In operation, parts are loaded into the machine manually from shop containers or direct from a conveyor discharging into the loading hopper. The parts are conveyed through the machine by a worm inside the drum, passing through a soak section, a spray section and finally a drain



section before being automatically discharged. Time in the various sections is controlled by the variable speed drive.

The machine is completely self-contained, incorporating cleaning solution pump and motor, variable speed drive and motor, ventilating blower and motor, solution temperature controls and solution tank with access door to solution-filtering screens. The solution tank may be heated by steam, gas or electricity. Motor controls are mounted in a single enclosure with interlocked disconnect switch.

E—108. SOLVENT—Kelite Corporation announces the development of a new multi-purpose safety solvent, Spray White E (Patent in process).

Spray White E, which is water dilutable is intended for maintenance cleaning of aircraft (exterior and interior), machine tools, light fixtures, and other hard surfaces. It is claimed to be safe on all common metals and durable painted surfaces. It will not dull paint gloss. Furthermore, the product is safe and non-toxic to personnel under normal conditions of use.

It is free of caustic chemicals and chlorinated hydrocarbons and is non-flammable. It is strongly buffered to maintain a low *p*H over a wide range of dilutions. It is effective on both oil wetted and water wetted soils.

E—109. NICKEL CHLORIDE—A new nickel chloride with less water of hydration and demonstrating marked improvements over that which was previously available has been developed by The Harshaw Chemical Company.

Called NiChlor 31, this new product has a typical average of 31 per cent nickel compared to 24.5 per cent in ordinary nickel chloride. This means that 0.8 lb of NiChlor 31 is equivalent to 1 lb of regular nickel chloride and results in easier handling and storing.

It is non-caking, uniform, and of high purity, with quick dissolving characteristics

E—110. ALKALINE STRIPPER—A new alkaline-solvent compound, designed to strip acrylic, alkyd, and other resistant paint finishes, has been announced by Oakite Products, Inc.

Oakite Stripper 150 is claimed to remove difficult paints in a simple soaking operation. It may be used in ordinary steel tanks, is safe on steel and magnesium, and inhibited against attack on aluminum, zinc and brass. It has no flash point, and contains no phenolics. A wax seal on the surface of the compound retards evaporation, increases life of the stripper.

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E—111. VIBRATOR FINISHERS—Productive Equipment Corporation announces a newly designed line of Selectro Vibro Finishers.

Designed to provide deburring, descaling, burnishing and coloring operations for virtually every size and shape part without marring or distortion, they deburr, descale and finish inside surface and hard-to-get-at areas regardless of size of openings.

Selectro Vibro-Finisher's drums are interchangeable and are available in many varied sizes, including multiple sectional drums for different types of material, requiring different media and finishing time, in the same operation. Vibrating mechanism is positive eccentric with adjustable stroke instead of the unbalanced pulley (offset weight) method.

E—112. BUFFS—After intensive research and field testing, American Buff Co. has developed the "Golden Tacky" buff treatment which, it is claimed, strengthens and conditions the buff, resulting in faster cutting, streakless, smoother finishing and increased compound-holding characteristics. It binds together the fibres of cotton or sisal buffs, providing firmer body and eliminating loose, frayed fibre ends. Longer wearing and harder cutting, "Golden Tacky" treated buffs are said to retain normal flexibility.

E—113. QUARTZ HEATER—New Heat-Pak heaters are said by the manufacturer, Electrical Accessories Co., Chemical Equipment Division, to provide more efficient heating, last longer and save space. Available both for acid and alkaline baths, the novel features of the electrical heater assure efficiency and trouble-

free operation. Departing from the conventional design of immersion heater, the Heat-Pak unit comprises one or more completely submersible sealed elements of fused quartz or metal, operating independently of each other. Elements are mounted in a compact rectangular cage or holder that fits between the anode bars and sides of plating tanks. The submerged elements are mounted horizontally to provide maximum exposure of the heating surface. Elimination of internal cores of quartz heaters reduces initial heatup time, and avoids undesirable surface temperatures detrimental to the solution. Elements are always located well below the liquid surface, yet have ample clearance at the tank bottom to avoid sludge deposits. This eliminates operational failure through liquid evaporation or deposit accumulation on the elements.

E—114. FLEXIBLE GRINDING WHEEL—A new, miniature flexible grinding wheel has been announced by Merit Products, Inc. The small Grind-O-Flex is available in 2½ or 2 in. diameter. It can be used on fixed or portable shafts at speeds up to 15,000 rpm.

Constructed of scores of thin, flexible abrasive strips, the new miniature Grind-O-Flex comes in a variety of grits. Designing of the wheel is such that fresh abrasive is constantly exposed as the wheel is used.

E—115. POROUS METAL FILTER ELEMENT—Commercial Filters Corporation has developed a sintered 316 stainless steel filter element adaptable to any CFC Fulflo Filter.

The CFC porous metal element is designed for the filtration of fluids with characteristics incompatible with ordinary filter media, particularly corrosive, high temperature and high viscosity fluids. It is available in uniform 40, 20, 10, 5 and 2 micron particle-retention ratings.

E—116. DEBURRING MACHINE—A new deburring and finishing machine, recently designed by Almco Precision Finishing, saves on floor space and is low in cost. Model DB-1616 called the Space Saver, takes up only 4.8 sq ft of floor space.

The total capacity of the two-compartment barrel is two cubic feet, each octagonal container measuring 16 by 8 in. A single compartment barrel measuring 16 in. in length and diameter is available as optional equipment. Barrels are lined with 1/4 inch abrasive-resistant plastisol.

E—117. POLISHING AND BUFFING MACHINE—A new semi-automatic polishing and buffing machine for finishing bicycle wheel rims is now available from Acme Manufacturing Company.

Basically, the machine consists of a heavy duty rotating work holding fixture and two Acme L-8-L fully adjustable lathes.

The rotating work holding fixture consists of a series of clamping segments, actuated by an air operated scroll. This arrangement insures proper concentricity of part and adequate holding pressure. Because of the heavy duty construction of the work holding fixture the lathes can be utilized for high pressure polishing or buffing operations to help reduce finishing time. Production rates can vary from 60 to 120 polished or buffed rims per hour depending on the specific application.

E—118. BARREL FINISHING—A line of 5 different model barrel finishing units designed for the finishing and definning of both metal and plastic parts has been announced by Tumbl-L-Matic, Inc.

Designated as Type LS, the complete units incorporate barrels which range in size from 21 in. in diameter and 20 in. long to 30 in. in diameter and 48 in. long with either single or double compartments.

The machines include, as standard equipment, welded channel iron framework, octagonal patented sheet steel barrels with hard maple liners, guarded chain drive, variable speed motor, unloading tray and screens and removable door with quick opening latches.

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TRADE LITERATURE

L—101. BUFFING AND POLISHING SPEED CALCULATOR—Hanson-Van Winkle-Munning Company has announced the availability of a handy 3 × 5 inch disc calculator for determining the surface speed of both buffing and polishing wheels.

The calculator, printed in two colors, gives easy-to-use instructions on how to find the surface speed, in feet per minute, of any wheel from 1 to 60 in. in diameter, turning at spindle speeds from 220 to 20,000 rpm.

L—102. CHROMATE CONVERSION COATINGS—A new single-dip clear chromate conversion coating for cadmium is fully described in Technical Data Sheet No. 73, a two-page usage and instruction sheet prepared by MacDermid Incorporated.

Called MACro Brite C-9, the product is a dry acid salt which produces a bright clear chromate finish on cadmium. The finish offers protection against fingerprinting, staining and the formation of white corrosion products. No liquid acid is required to make up the solution, so carboys are eliminated and controls are simplified.

A new single immersion, clear chromate conversion coating for zinc plate is fully described in MacDermid's three-page Technical Data Sheet No. 58.

Called MACro Brite 2, the product is a dry powder acid salt used to produce clear bright finishes with a chromium-like blue tint. The product replaces nitric acid bright dip, giving more uniform results, easier control and better corrosion resistance at no extra cost.

This new chromate conversion coating may be used in applications requiring a low-cost, blue-bright finish with improved corrosion protection over zinc plate. Parts may be processed on racks, in barrels or in bulk.

L—103. METAL CLEANER—A new type of low-cost metal parts chemical cleaner is described in literature available from Pall Corporation. The literature shows a photograph of the cleaner and also shows an exploded view with all basic parts noted. Pall-Clean solutions, for the finishing stainless steel, Monel, nickel and aluminum surfaces to high levels of brightness and cleanliness, are described.

The cleaner is said to remove encrusted carbon, weld oxides, brazing flux, varnish and paint. It contains no moving parts or electronic tubes.

L—104. SELECTIVE PLATING—Selectrons, Ltd., New York City, has just issued an eight-page booklet, Bulletin I, available on request, listing varied engineering applications of a new, high-speed selective plating process. In addition to discussing problems solved by the new method, the brochure lists available equipment, techniques, and results achieved. It also has a one-page question-and-answer section for a quick overall idea of process capabilities.

L—105. ELECTROPLATING PROCESSES—Hanson-Van Winkle-Munning Company has announced the availability of a new bulletin that briefly describes all H-VW-M electroplating processes.

The two-color, 24-page bulletin gives a brief description of 18 H-VW-M processes which include the company's three new nickel processes: Levelume 220, the improved Levelume, Permalume, the latest semi-bright process that can be continuously carbon treated and Superlume, the premium super bright, super-high-leveling bright nickel bath.

New conversion coating processes Chem-Rite A-22, a conversion coating for aluminum and Chem-Rite Z-33, clear conversion coating for zinc are also briefly described.

Other processes covered are Cadalume, Copper-Lume, Nickel Sulfamate, Silver-Lume and Zincalume.

L—105. LABORATORY INSTRUMENTS—Sixteen-page LaPine Apparatus Review 12 announces many new laboratory instruments: spectrophotometers, *p*H meters, electrobalances, recorders, and related equipment.

L—107. SEMI-AUTOMATIC CONVEYOR—Hanson-Van Winkle-Munning Company has announced the availability of a new semi-automatic conveyor bulletin, No. SA-104.

The new, two page color bulletin illustrates and describes such semi-automatic conveyor features as variable speed drives, horizontal agitation, typical current carriers and drive mechanisms.

The Standard semi-automatic conveyor features heavy-duty carriers with self lubricating collector fingers for large current loads. Large forgings and heavy castings can be handled easily. Light, bulky, or buoyant stampings are held in rigid, continuous contact. Inside anode circuits can be provided.

Two schematic diagrams and a table of specifications complete the description of the unit.

L—108. CHROMATE COATING CHART—A new Selector Chart, which enables a metal finisher to match the proper chromate coating to the type of finish desired, is available from MacDermid Incorporated. In addition to showing the type of finish desired, the Selector Chart indicates the color of various coatings, refers to the appropriate MacDermid data sheet number and lists the government specification number met by the company's three dry powdered chromate conversion coatings.

L—109. POLYESTER TANKS—The Poly-Fibre Associates has issued a 10-page bulletin describing their plating and process tanks, fume hoods, exhaust stacks and other products.

L—110. ULTRASONIC LIQUID-LEVEL SENSORS—Acoustica Associates, Inc., has prepared for release a new folder describing its unitized liquid-level switch which combines an ultrasonic probe and a transistorized control into an integral unit.

In addition to specifications, the folder also relates how the liquid-level sensor, either as an integral or separate unit, is capable of monitoring a large number of liquids.

PERSONALS

NELSON FORAN recently joined the management staff of Graphik-Circuits, Division of Cinch Manufacturing Company, as assistant to the vice president and general manager. Prior to joining Graphik-Circuits he was a member of the research and development staff of Photocircuits Corp., Glen Cove, New York.

Mr. Foran attended New York University and Brooklyn Polytechnical Institute of Technology. During World War II he served in China as a Naval Intelligence Officer. In 1946, Mr. Foran joined the Specialized Plating Company of Brooklyn where he acquired a background of practical plating experience. He later joined the staff of Fairchild Engine Company where he supervised work for the Atomic Energy Commission and the operation of the largest nickel plating installation in the East.

He is presently engaged in the development of new and improved plating methods for high reliability printed circuits.

N. Foran

K. F. Vogt

KURT F. VOGT has been named to the newly-created position of vice president—marketing for Acoustica Associates, Inc.

Mr. Vogt, who joined Acoustica in 1959 as director of marketing, formerly was associated with Ritter Company, Inc., of Rochester, N. Y., as marketing manager; with Air Reduction Company, Inc., New York, as assistant sales manager, and was a marketing consultant for the Siemens Company.

♦

M. S. GREEN has received appointment as chairman of the board and **R. H. WRIGHT** as president of Armalite Company Limited.

Mr. Green, one of the founders of the company, has occupied the position of president since 1956. In his new post he will also assume the executive duties of treasurer.

Mr. Wright, before joining Armalite in 1956, was associated with Dow Chemical of Canada Limited where he held the position of sales manager. Widely experienced throughout the Canadian chemical industry, he was Armalite's vice president in charge of marketing prior to his appointment as president.

M. S. Green

R. H. Wright

In his new capacity, Mr. Wright will assume the duties of chief executive officer of the company. Both men are members of the American Electroplaters' Society.

♦

BEN P. SAX has been elected president of the newly-formed Mid-North Small Business Investment Corporation, Chicago. Mr. Sax is chairman of the board of American Buff Co., Chicago, and president of J. J. Seifen Co., Detroit, Mich. The new corporation maintains offices at 111 North Wabash Avenue, Chicago, Illinois.

♦

JOSEPH F. KOTKOWSKI has joined Rapid Electric Company as project engineer at the Brookfield, Connecticut plant.

He is a graduate (BSEE) of the University of Connecticut.

As project engineer Mr. Kotkowski is presently engaged in a 2 mega-watt power application for an Atomic Energy installation.

Prior to joining Rapid, he functioned as a distribution engineer for Norwich Gas & Electric Company. Previous posts were with Sikorsky Aircraft and Doman Helicopter Inc., as chief design-test engineer and operations manager of electronic and servo mechanisms for aircraft instrument simulators.

♦

MARTIN H. POLLACK of Brooklyn, N. Y. has joined the Sethco Manufacturing Corp., where he will be responsible for design development and improvement, as well as exploring methods for solution filtration. He will also offer technical assistance to distributors and users of Sethco Products.

Mr. Pollack brings broad experience to his new affiliation. He has been associated with the metal treating industry for the past 20 years in various capacities. He has held technical-executive positions with Spectranome Plating Corp., New York City, Vernon Plating Work, Division of the De Jur-Amsco Corp., Long Island City, N. Y. and the Kearny Works of the Western Electric Company.

Founder of the Enley Products Corp., Brooklyn, N. Y., he designed the "Demon" and "Pup Reactor" water demineralizers and other ion exchange equipment. He holds several patents in the electroplating field.

Previous to his service in the U. S. Navy during World War II, Mr. Pollack organized the Heat Treating Consulting Service of New York City, which engineered many installations for metal treating and hardening.

A graduate of the College of the City of New York, he is at present working on his master thesis in metallurgical engineering at the Polytechnic Institute of Brooklyn.

M. H. Pollack

G. M. Herring

GLENN M. HERRING has been named to the position of assistant sales manager of Hanson-Van Winkle-Munning Company. This follows and supersedes Mr. Herring's appointment earlier this year as assistant to the vice president—sales.

In his new capacity Mr. Herring will be assigned to general company sales responsibilities with particular emphasis on equipment negotiations. In that area, he will assist field personnel with home office cooperation and will maintain constant liaison with the engineering department. He will continue to be in charge of the Eastern sales district.

Mr. Herring joined the H-VW-M sales force in 1930 as a sales trainee. He was appointed sales representative to the Pittsburgh area upon completion of this course. In 1955 he transferred to the home office in Matawan and was appointed

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manager of steel mill sales. Three years later, he was appointed to the post of district manager—Eastern states (Maine to Florida).

A graduate of Lafayette College, he received his BS in 1930. He is an active member of the American Electroplaters' Society, Association of Iron and Steel Engineers and the University Club of Pittsburgh, Pennsylvania.

♦

MYRON B. DIGGIN of the Hanson-Van Winkle-Munning Company was elected chairman and **DR. R. B. SALTONSTALL** of the Udylite Corporation, secretary to serve terms of two years at the twenty-eighth meeting of the Surface Preservation Section, Production Techniques Division, American Ordnance Association held at El Paso, Texas and White Sands Missile Range, New Mexico the first of November.

Industry members of this section work closely with governmental and military personnel in an attempt to solve problems relating to the corrosion or deterioration of military material.

♦

DR. EDWARD A. PARKER has been promoted to technical director and **JAMES A. POWERS** to research director of Technic, Inc.

Dr. Parker has been with the Providence-based firm since 1945. Mr. Powers joined Technic in 1957.

Mr. Powers succeeds Dr. Parker as research director. The post of technical director is newly created.

Before joining Technic, Dr. Parker was associated with Alrose Chemical Co., Cranston, R. I., for three years. He received his Bachelor's, Master's, and Doctor's degrees from the University of Illinois.

Dr. E. A. Parker

J. A. Powers

He is a member of the American Chemical Society, Electrochemical Society, American Society for Testing Materials, American Electroplaters' Society, American Institute of Chemists, Institute of Metal Finishing in England, and Sigma Xi scientific fraternity.

Mr. Powers, who was research chemist on the company's staff before his promotion, previously was associated with Olin Mathieson Chemical Corp. and Geigy Chemical Corp.

A member of the American Electroplaters' Society and American Chemical Society, he has a Bachelor's degree from Providence College and Master's degree from the University of Notre Dame. He was graduated Magna Cum Laude from Providence and held a teaching fellowship at Notre Dame.

♦

FRANK MACIOCE, who has been director of ion-exchange activities at Industrial Filter & Pump Co. of Chicago for the past 11 years, has joined the New York office of Illinois Water Treatment Co. of Rockford, Illinois. He will concentrate his efforts in the metropolitan area

Mr. Macioce received his engineering BS in 1934 from the College of City of New York, and a degree in chemical engineering the following year from the same institution. Before going to Chicago in 1949, he was for three years employed in the ion-exchange products department of American Cyanamid Company in New York.

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F. Macioce

R. Lee

RALPH LEE has been appointed director of the newly-formed technical layout service department announced by J. Holland and Sons, Inc. As director, Mr. Lee and his staff will study a customer's electroplating production requirements, recommend processes and suggest the type, quantity and placement of the necessary equipment.

♦

LAWRENCE O'HANLON, formerly chief designer with Titeflex, Inc. and their successor in the filter field, Croll-Reynolds Engineering Company since 1949, has been appointed chief design and application engineer for their Filter Division by The Meaker Company, subsidiary of Sel-Rex Corporation, manufacturers of semi-conductor rectifier equipment, automatic metal processing machinery and liquid clarification filters.

Mr. O'Hanlon, who attended California Institute of Technology and the University of Oregon concentrating in Mechanical Engineering, has held responsible technical and administrative positions in industry since 1938 including assignments with Western Electric Company, General Machine Company, Metalwash Machinery Company, and Randall Manufacturing Company. He has served as a Design Consultant to the processing industry for unfired pressure vessels, chemical processing systems and equipment, fluid handling systems, electro-pneumatic systems for chemical control, and aircraft ground service equipment. In his positions with Titeflex and Croll-Reynolds Engineering Company, Mr. O'Hanlon had complete responsibility for design, estimation, fabrication, installation and service of chemical filtration systems.

♦

FREDERICK S. FOSTER, a vice president of The Hubbard-Hall Chemical Company will head the heavy chemicals department.

♦

THEODORE Z. VOYDA, assistant vice president of Hubbard-Hall will manage the metal finishing department. In this position, he will head the department's technical, research and sales staffs.

T. Z. Voyda

C. T. Kellogg

♦

CHARLES T. KELLOGG, assistant treasurer of the company, will be manager of the distributor sales department, which services distributors handling Hubbard-Hall anodes and metal finishing supplies.

♦

H. R. STITELY has resigned as president of Lord Chemical Corporation of York, Pa. and will continue as a director and a consultant. **PAUL H. SETZLER** is named vice president and general manager.

JAMES F. CONNAUGHTON, president of Bell Intercontinental Corporation of which Lord is a subsidiary, succeeds Mr. Stitely as president.

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DEVELOPMENT OF PROTECTIVE COATINGS FOR REFRACTORY METALS, by C. G. Goetzel and others, New York University, for Wright Air Development Division, U.S. Air Force. Feb. 1960. 57 pages. (Order PB 161736 directly from Office of Technical Services, U.S. Department of Commerce, Washington 25, D. C., $1.50.)

Results of tests to develop high temperature protective coatings for refractory metals showed that tungsten wires can be protected against oxidation in stagnant of flowing air at temperatures up to 3000F for periods up to 20 minutes by applying a multi-layer coating of chromium, silicon and rhodium. The maximum oxidation resistance temperature achieved with the multiple coating was 1000F above that for unprotected pure tungsten. The researchers believe further improvements can be made if complete diffusion alloying, bonding and melting of the surface coat is achieved over the entire length of the specimen.

♦

DESIGN FOR METAL FINISHING, published by Institute of Metal Finishing, 32 Great Ormond Street, London, W. I., England.

A newly published sixteen-page booklet, "Design for Metal Finishing," outlines the essentials of the polishing, plating, and painting processes, and discusses their limitations as they relate to design.

While somewhat elementary in comparison with such technical treatments as, for example, that found in the "Electroplating Engineering Handbook," the booklet has a graphic impact which is well suited to the purpose of impressing such people as product engineers and designers with the possibilities of cost reduction and product improvement by attention to even relatively simple factors in the design which can have a profound effect on the ease and effectiveness of the finishing processes.

A tabulation of minimum thicknesses of electroplated castings is included, and gives a good cross-section of British practices in this respect for a variety of applications.

James H. Lindsay
Ternstedt Division
General Motors Corporation

♦

THE SURFACE CHEMISTRY OF METALS AND SEMICONDUCTORS, edited by Harry C. Gatos. John Wiley & Sons, Publishers. 526 pp. Non-members, $12.00; Members, $10.50.

This book, which contains the papers delivered at the 1959 Joint Symposium of the Corrosion and Electronics Divisions of the Electrochemical Society on the subject of Surface Chemistry of Metals and Semiconductors, represents an ambitious attempt to bring the large but rather diffuse body of knowledge gathered over many years on the subject of metal surfaces, to bear on the relatively brand new and intensively studied field of semiconductors —and vice versa. To be perfectly frank with the majority of readers of this magazine, it is not a book for platers.

For electrochemists, metallurgists interested in surface properties of metals and near metals and for those studying the physics and chemistry of the solid state however, the book should hold considerable interest, for it brings together under one cover a great deal of information which has hitherto been widely scattered in the literature. It begins with a brief introduction to the physics and chemistry of surfaces by none other than W. H. Brattain, co-inventor of the transistor and Nobel Laureate, then goes on to cover a variety of pertinent topics such as properties of surfaces, polishing damage to surfaces, effect of imperfections, electrode reactions, electrolytic etching of metals and semiconductors, dissolution of metals, adsorption and chemisorption and ending with a section on oxidation processes. Almost every aspect of the surface properties of metals and semiconductors is reviewed and brought up to date by the twenty odd authors, each an expert in his respective field. In addition there are informative comments made by a number of surface scientists who contributed to the discussion of each paper. Of particular value are

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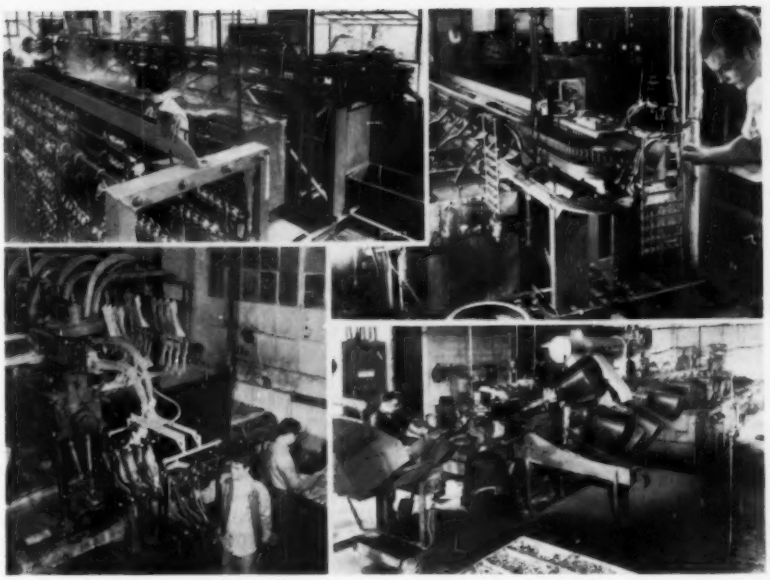
the in-the-main comprehensive bibliographies accompanying each paper, which enables a reader interested in a specific phase of surface phenomena to study the subject in greater detail.

On the physical side, the book, as far as this reviewer is concerned, is a disappointment. The volume s an expensive one as far as books go. Inflation or no, certainly $12.00 is not hay. Yet, for some unfathomed reason, the text is printed by offset direct from the typed manuscript pages. As a result the right hand margins are displeasingly irregular, the mathematical formulas with subscripts and exponents as large as coefficients are "way out" in appearance and last but not least, improperly cleaned and hit typewriter keys along with one or two strikeovers (It seems even electric typists are guilty of these cardinal sins!) contribute nothing to the beauty of the printed pages. (Note to publishers: If you ever use this same electric typewriter for setting type, please do something about the upper case W and A!)

Perhaps this is picayune carping in view of the valuable contribution to knowledge that this book makes. Nevertheless, it seems to me that the excellent line drawings and micrographs deserve better typographical surroundings and the authors' words a nicer setting than the publishers have seen fit to provide.

DR. JOSEPH B. KUSHNER
Metal Finishing Consultant



INTERNATIONAL INTEREST IN AUTOMATIC PLATING

Increasing awareness abroad of the advantages of automatic metal finishing is predicted. The photographs above of the general type of automatic machines in international use are through the courtesy of the Metal Finishing Division of Frederic B. Stevens, Inc., Detroit. (Top, left) Automatic plating machine, (top, right) rack machine, (bottom, left) full automatic zinc plating machine, (bottom, right) barrel plating machine.

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BRANCH NEWS

Total AES Branches U. S., Canada, Australia, January 1, 1961—59.

BOSTON
Clarke on Iron Plating

The regular meeting of the Boston Branch was held on December 1 at the Hotel Statler-Hilton.

Alfred T. Clarke, specialist on finishes at General Electric Co. in Lynn, Mass. was guest speaker for the evening. His topic was "Iron Plating." He has been a member of Boston Branch for some time, and was selected for speaker on "New Members Night" for several reasons. One is that iron plating is being revived to a more important position than a replacement for scarce metals or restrictions from arbitrarily made shortages. Increased use is coming from the electronic industry and the various defense programs.

Al has had quite a varied experience in this field and told quite readily "what not to do." Most of the iron plating solutions are quite messy to handle and leave behind an extensive collection of evidence of corrosion problems. He has been through all of this and knows the advantages and disadvantages for commercial use.

The other reason for having Al was to demonstrate that Boston Branch has members with an excellent background on the technical side of plating and benefits should start at home.

George P. Swift
Secretary

BLUE RIDGE
Murphy Speaks on "Acid Inhibitors"

The Blue Ridge Branch held its regular monthly meeting on November 4, 1960 at the Elks Club in Roanoke, Va. Nineteen members and guests attended the meeting. Seven visitors were introduced.

At the business meeting, four new members were elected.

After the business meeting **Bruce Wallace** introduced **Dr. Nelson Murphy** who presented a talk on the topic "How Acid Inhibitors Work." Dr. Murphy is a Branch member and a research professor in the chemical engineering department of Virginia Polytechnic Institute. He defined an inhibitor as a substance added to acid dips to prevent the attack of the base metal after the undesired oxides are removed. Various types of inhibitors were discussed. He stated that without an inhibitor 65 pounds of metal must be removed in order to remove six pounds of metal oxide. A good inhibitor must be soluble in acid, non-toxic and react with oxides but not with the metal. The various inhibitors may perform better in one acid than another. The best way to remove small amounts of metal oxides is with an acid dip and these dips perform better when they contain inhibitors.

Donald H. McGee
Secretary

BRITISH COLUMBIA
Executive Meeting Places Amos in Charge Christmas Party

The executive meeting was held at the office of the Coast Testing Laboratories at 7 p.m. on November 4.

The following members were present: **G. Smith, B. Marquardt, Jim Hurford, H. Schenke, C. Schlossareck, N. Shepherd and G. Amos.**

Discussion took place on a Christmas Party for next month, and G. Amos was unanimously appointed head of the committee.

C. Schlossareck
Secretary

BRITISH COLUMBIA
Bellinger Talks on Trouble Shooting

The general meeting was held on Monday, November 7, at 7:30 p.m. in the Loughead Hotel, Burnaby, with Vice President **Heinz Schenkie** in the chair.

The guest speaker, **K. P. Bellinger** of the Conversion Chemical Corporation, Rockville, Conn., was introduced by **J. Lee.** The subject of his talk was "Trouble Shooting in the Plating Room," particularly stressing cadmium and zinc dyes for industrial purposes, and color coating on zinc.

The ensuing question and answer period lasted until the meeting adjourned at 10.30.

C. Schlossareck
Secretary

BUFFALO
Pressure Filters Discussed by Sward

The Buffalo Branch held its third meeting of the new season on Friday, November 4, 1960 at the Niagara Manor, Buffalo, N. Y. with 30 members and 2 guests in attendance.

President **Harold Shapiro,** introduced the guests of the evening.

He welcomed back **Ray Blechinger,** who is just recuperating from a lengthy illness. Mr. Blechinger thanked all the Branch members for their thoughtfulness in sending him a basket of fruit, which was delivered by **Joe Ruff.**

John Donaldson, chairman of the membership committee, announced he has approximately seven prospective new members.

Chuck Fotheringham, chairman of the forthcoming Christmas Party to be held Saturday, December 3, 1960, stated the committee has planned an evening's entertainment that should prove worthwhile to members and guests. It will include gifts for the ladies, roast beef dinner, door prizes, dancing and entertainment.

It was announced by **Bert Kirchoff** that **Robert Potter** passed away at home after being ill for quite some time. A moment of silent prayer was offered for Bob Potter, a long time member of the Buffalo Branch.

Our librarian, **John Tiebor,** introduced the speaker of the evening, **Ted Sward,** assistant sales manager of the Industrial Filter and Pump Mfg. Co. Mr. Sward presented an informative talk on types of pressure filters most often found in the filtration of electroplating solutions and a discussion of the advantages and operating characteristics of each type. Mr. Sward also distributed to all members tables showing the flow rates for various plating baths.

Following the talk, Mr. Sward held an open question and answer period from the floor.

Robert C. Eich
Secretary

CHICAGO
Informative Organic Finishing Panel

The regular meeting of the Chicago Branch was held on Friday, November 11, 1960, at Petricca's Restaurant, 510 North Western Avenue. One application for membership was received and three new members were elected to the Branch. **Joe Corre** read a letter from **Lou Ragne,** chairman of exhibits of the 2nd Annual Midwest Conference which was held at South Bend, Indiana, commending the Chicago Branch for their fine exhibits. An early reminder—the annual educational session and banquet will be held at the Conrad Hilton Hotel on Saturday, January 28, 1961. **Si Gary,** librarian, has arranged for **Ezra Blount,** editor of *Products Finishing*, to talk on "Plating Practices in Japan and the Far East" and **Myron Diggin,** technical director of Han-

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.

son-Van Winkle-Munning Co., to speak on "Plating Practices in Europe and Asia." **Scott Modjeska,** chairman of the Banquet Committee, and his group are working hard to make the banquet more than worth attending.

Art Bartmann of Bell and Howell, a member of the librarian's committee, conducted a panel discussion on "Organic Finishing." The members of the panel were **Curtis Simmons,** president of Enameled Steel and Sign Company; **Maurice F. Loeffel,** who substituted for **Charles Burak,** of Macco Products Company; **Joseph Pokorny,** chemist and service engineer of the Blakeslee Company.

Mr. Simmons spoke on the aspects of applying paint by electrostatic means. A small disc, 4" in diameter, rotating at 5000 rpm and highly charged with voltage, is used to atomize the paint and causes it to be attracted to the parts which act as grounds. He discussed the following methods of applying paint by electrostatic means (1) airless (2) using air and (3) lastly a dip process.

Mr. Loeffel spoke on "Phosphatizing" and described a five stage process. The first stage was a preclean, an emulsion cleaner at 160–180F followed by (2) a hot water rinse (3) phosphating tank, 1–2 oz/gal at 160F followed by (4) a water rinse and lastly (5) a sealer using chromic acid and then oven dried. The lower *p*H bath 3.5–4.5 used for phosphating is preferred because a deeper etch is obtained on parts such as steel, aluminum and zinc-die cast. In phosphatizing steel, a complex ferric oxide is formed on the surface and from 40–70 mg/sq ft are formed no matter how long a time the steel is left in processing tank. However, when treating zinc in this process, a build-up of the coating is obtained, and it may run from 40–1800 mg/sq ft. Zinc and aluminum form complex phosphates when processed in this manner.

Mr. Pokorny spoke on the trichlorethylene base paint system of coating materials. The temperature of trichlorethylene vapor is 188F, when oil or greases are added to trichlor the boiling point is increased. Resins and pigments to be used must be compatible with the trichlorethylene. If the paint system is super heated to 220–230F and the parts are heated to above 188F, the resin and pigments and deposited on the parts and no "defilming" occurs by the trichlorethylene vapor. Coatings that are applied may vary from 0.0003 mil to about 1 mil. Some of the alkyd coatings so applied run from 1.3–1.4 mils. Using the liquid dip paint system, higher thicknesses may be obtained, from 0.5–2 mils. A very lively question and answer period followed and the chairman and members of the panel were given a rising vote of thanks for their interesting talks and discussion.

Christopher Marzano
Publicity Chairman

COLUMBUS
Jackson Speaks on Controls; Tri-State Speakers Announced

The Columbus Branch held its second regular meeting of the year—and its first dinner meeting—at Presuttis Villa on Friday evening, October 7, 1960, the president in the chair. Two new members and two newly transferred members were introduced.

Cal Smith, chairman of the Tri-State Meeting committee, reported on committee activities. The Tri-State meeting will be held February 4, 1961 at the Deshler Hilton Hotel here in Columbus. Tickets will be sold for either the educational session alone or for the combined educational and evening sessions. **Bill Safranek** stated these speakers will take part in the educational session:

(1) **William Geissman** on AES Project 18, "Buffing of Die Castings"; (2) **Manuel Ben** on "Plating of Aluminum"; (3) **Walter Pinner** on AES Project 15, "Accelerated Corrosion Testing"; (4) **Frank LeQue** on "Materials in Outer Space"; (5) **Robert Anderson,** subject to be announced later.

The two delegates to the Supreme Society, **William Neill** and Bill Safranek, reported on the July meeting of the Society. They stated there is a need for strengthening the regional groups

Jim Harlow, librarian, introduced **Joseph Jackson** of R. O. Hull Co. Mr.

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2 — Production Machine #101 — 10 H.P.
2 — Acme A2
3 — Acme B10
2 — Divine Model VM-10
10 — L'Hommedieu 5 H.P. variable speed
15 — Holland 5 H.P. — 10 H.P.
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14 — Detrex and Blakeslee Degreasers
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1 — 6000/3000 ampere, 9/18 Volt, 40°C Chandeysson, Synch. Exciter-in-head.
2 — 5000/2500 ampere, 6/12 Volt, 25°C Chandeysson, Synch.
1 — 4000/2000 ampere, 6/12 Volt, H-VW-M, Synch, Exc.-in-head.
1 — 3000/1500 ampere, 12/24 Volt, Chandeysson, Exciter-in-head.
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10 — Duskop Dust Collector Cabinets, Sizes No. 550, No. 850, No. 1100
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Jackson gave an interesting account of controls used in the electroplating industry. His talk was followed by an enthusiastic question and answer session. The meeting adjourned at 11:00 p.m.

Mary Fulmer
Secretary

COLUMBUS

Rigid Plastics Discussed by Kramer

The Columbus Branch of the AES met at Battelle Memorial Institute on November 4, 1960, the president in the chair. The Branch has 64 paid members.

Marvin Pingle reported that he had contacted 102 suppliers and had sent publicity folders to Louisville, Indianapolis, Dayton, Cincinnati and Cleveland regarding the Tri-State Meeting that will be held in Columbus, February 4. A motion was made and adopted that the board be asked to consider using Branch funds for paying service charges and tax at the Branch dinner meeting.

Charles Kramer of Marine Products spoke on applications of rigid plastics in plating rooms especially in regard to their corrosion resisting properties. Mr. Kramer is well known as an expert in this field. His presentation was excellent.

Mary Fulmer
Secretary

DALLAS-FORT WORTH

Nichols Talks about AES, Rinehart Tells of New Plating Installation

The Branch met October 19, 1960, at Howard Johnson's Turnpike Restaurant, with 40 members and guests present.

After a social hour and fine dinner, the meeting was opened by President **William Aves.** A motion was made by **Don Allie,** seconded by **Myron Browning** and **E. R. Rinehart,** that the Dallas-Fort Worth Branch endeavor to obtain the 1967 National Convention for this area.

The Committee for Project No. 20 reported that **Dr. R. L. Hoyle** from Arlington State College, midway between Dallas and Fort Worth, had been selected to conduct this investigation.

Myron Browning then introduced **John P. Nichols,** National Executive Secretary of AES. He outlined the structure of the AES, and the duties of the Branches, and emphasized that the aim of the AES is to educate and improve through the sharing of technical knowledge. He said that the AES is expanding, and that it would install its 59th Branch in Memphis on October 21, 1960. Among many other subjects, he discussed the various awards and recognitions available in the Society.

President William Aves then introduced **E. R. Rinehart** of Chance Vought Aircraft who discussed the new plating and heat treating facilities recently installed at Chance Vought. He pointed out that it had taken long months of planning and negotiations before agreements were made to invest approximately $2,500,000 in the project. Now that the actual installation is nearly completed, it is a tribute to the company and the men who planned it.

Both speakers were enthusiastically received by the members and guests.

A drawing was held for the door prize, and **Milt Davison** won the musical beer stein.

Jack D. Haler
Recording Secretary

DENVER

Technical Motion Pictures Shown

The Denver Branch met November 10 at the Oxford Hotel. During the business meeting a discussion was held concerning a spring social. Two new applicants were introduced and elected.

After the business meeting two movies were shown on the chemistry of electroplating. The first dealt with the concept of the electron and what takes place at the electrodes. The second film showed the application of electrochemistry to electrowinning of copper.

Elmer Schuster
Secretary

DETROIT

Three Speakers Discuss Plating on Aluminum

The regular monthly meeting on November 4 at the Statler-Hilton Hotel was devoted to the subject of "Plating on Aluminum." **Ralph Williams** of Pontiac Motor Division, General Motors Corporation, was the technical chairman.

The three speakers, covering various aspects of the subject, were **Dr. G. H. Kissin,** head of the Finishing and Electrochemical Branch, Kaiser Aluminum and Chemical Corporation; **K. H. Wagner,**

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development engineer, Alcoa Process Development Laboratories, Aluminum Company of America; and **E. F. Barkman,** research supervisor, Reynolds Metals Company.

W. C. Anderson

DETROIT

Automotive Trim Discussed

The Detroit Branch held its monthly meeting on December 2 in the Michigan Room, at the Statler-Hilton Hotel.

This was a meeting devoted to the subject "Service Performance of Automotive Decorative Trim." **Dr. W. Andrew Wesley** was the technical chairman. **G. G. Levy,** Chrysler Corp.; **V. Cassidy,** Ford Motor Co. and **H. A. Kahler,** General Motors Corp. were the speakers of the evening who supplied interesting information on the chosen topic.

W. G. Anderson

INDIANAPOLIS

Members Told How to Invest

Ladies' Nite was enjoyed by 53 members and guests on November 1, 1960 at the Construction League. **John Holland,** president, called the meeting to order.

Bert Hawbee reported on the Tri-State meeting at Columbus in February and asked that all members get behind it with their support. One application for membership was presented.

Special guests with us were **Ezra Blount** of the Cincinnati Branch and **Norman Rogers.**

The December meeting will have as guest and speaker **Chester Borlet,** AES national vice president, who will talk on "Filtering Plating Solutions."

The evening's program was most enlightening and interesting, with **Richard Neal** of an Indianapolis stocks and bonds firm talking on "Stocks and Bonds—Plain and Simple." We learned that thirteen million persons directly own stocks and one hundred million indirectly own stocks in insurance, pensions, retirements, etc. He told us the differences in various stocks and bonds and why some of them move more rapidly than others, how to buy them with professional help, and many other very interesting facts. A booklet "How to Invest" was given to each person. Many, many questions were asked concerning investment clubs, new insurance companies, why invest in this or that stock, etc.

Edna Rohrabaugh
Secretary

HARTFORD

Joint Meeting with APFA Held. Schneiders Discusses Adhesion

The regular Branch meeting was held at the Bond Hotel on November 21 and 69 members and guests were present. Since the subject was of interest to organic finishing people, this was a joint meeting with the American Production Finishers' Association, a local society dedicated to the advancement of organic finishing.

The guest speaker for the evening was **Frank Schneiders** of Enthone Inc. whose subject was "Adhesion."

Mr. Schneiders defined adhesion as the force necessary to hold two surfaces apart and to increase bond strength the following are resorted to: 1) Mechanical bonding, 2) Chemical bonding and 3) Chemical-Mechanical Bonding. For mechanical bonding, the rougher the surface the better the adhesion, or the smoother the surface the poorer the adhesion. Sand blasting roughens the surface for better paint adhesion, or acid pickling of metals for plate adhesion and anodizing of aluminum for paint adhesion. In chemical bonding, good clean surfaces allow the plate to deposit and follow the crystal structure of the base metal, oils smuts, dirt and oxide films decrease adhesion as also worked surfaces due to buffing and polishing. Slides were shown giving typical adhesion values of Nickel plating on various metals. In the chemical-mechanical bond phosphates on steel, chromates on various metals and zincates on aluminum were discussed. Adhesion as an important factor in corrosion resistance and ease of paint stripping were covered.

The technical chairman for the evening was **Harry Sanders.**

Stanley Platoz
Secretary

KANSAS CITY

Helbig Gives Uses of Activated Carbon

The first meeting on September 15 of the new season for the Kansas City Branch featured an interesting and timely talk on "Purification of Plating Solutions" by **Wilbur Helbig** of the Atlas Powder Co. Mr. Helbig gave the 24 members and guests present the benefit of his many years experience in the proper use of activated carbon for filtration of plating solutions. He began by describing the unusual properties of the material, the process involved in its manufacture, and listed the five other industries whose successful operation depend on its use.

In outlining the two basic methods of use for this filter materiel, Mr. Helbig detailed the impurities which can be removed with it and indicated the effectiveness and limits of each method. He also gave some sound facts and figures to guide in the choice of equipment for its proper use. Since the subject was of interest to all types of plating companies represented, the questions and answers which followed his prepared presentation bespoke the broad field of use of this particular material in all phases of plating processes.

The meetings for this new season will be held (as was this one) at the Berkshire Hotel, 1021 E. Linwood Boulevard, Kansas City, Missouri. Social hour at 6:30

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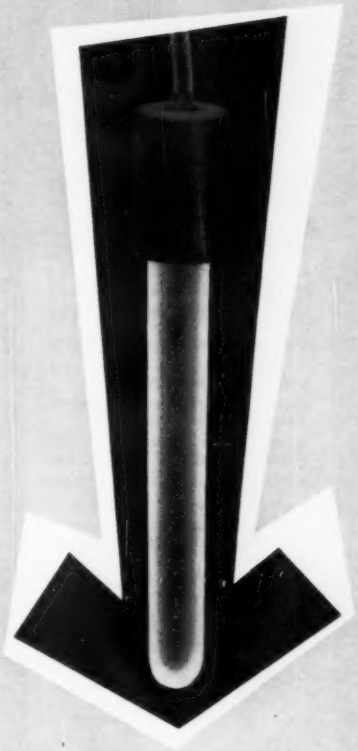

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p.m., dinner at 7:00, and the meeting at 8:00. Refreshments for this evening were courtesy of **E. T. Seahill,** and the dinner menu featured a delicious filet mignon.

The president, **Warren Eliot,** presided at the business meeting. A report on the status of the Branch outing October 15 to the Kansas-Oklahoma Football Game at Lawrence was given by **R. E. Loupee.** One application for membership was approved. First Vice President **William DesJardins** spoke briefly on his plans and requested the cooperation of all in increasing our membership. Warren Eliot pointed out that this Branch was represented on two of the Supreme Society committees, appointments to the Proctor Award Committee and the Credentials Committee having been made and confirmed from the National Office.

A motion was made, seconded and passed that this Branch prepare and present at the first opportunity, a formal invitation to the Supreme Society to hold the 1963 Interim Meeting in Kansas City.

Before introducing the speaker for the evening, Librarian Loupee announced that a program on ultrasonics would be the feature in October and also that this Branch would be favored with a visit from the National Executive Secretary, **John P. Nichols.**

Robert L. Garrett
Acting Secretary

KANSAS CITY

Nichols Installs Delegates and Speaks on AES, Carlson Discusses Ultrasonics

The October meeting of the Kansas City Branch was held at the Berkshire Hotel at 6:30 p.m. on October 13, 1960. Refreshments for the social hour were provided through the courtesy of the Davies Supply Company. Following a fine steak dinner, the meeting was called to order at 8:00 p.m. by President **Warren Eliot.**

R. E. Loupee gave final instructions concerning our fall social event—a trip to the Kansas-Oklahoma game at Lawrence, Kansas, on Saturday, October 15. Seventy-two members and guests are expected to attend. Two buses have been chartered for the group. Sandwiches and refreshments are to be available on the buses.

The matter of electing delegates and alternate delegates to represent the Kansas City Branch during the coming year was brought up. At this point, Warren Eliot introduced to the group AES National Executive Secretary, **John P. Nichols.** Mr. Nichols explained to the group the duties of the delegates and alternates, their responsibilities and importance to the functioning of the Society. After due consideration, **Glen Wilson** moved and **William E. Brumwell** seconded that the following serve as delegates and alternates: delegates: **Robert Garrett, Scott Sterrett, R. W. Davis;** alternates: **Robert Garland, Robert Johnson, William B. Harding.**

The motion carried on a voice vote. At the request of Warren Eliot, the delegates and alternates were officially installed by Mr. Nichols.

William DesJardins presented the membership application. This recommendation was acted upon favorably.

R. E. Loupee proposed that the Branch hold a party during the Christmas-New Year Holiday Season. A great deal of interest was shown in this proposal and Mr. Loupee requested that anyone having specific ideas in this regard contact him about them.

Warren Eliot turned the meeting over to John P. Nichols. Mr. Nichols prefaced his remarks by congratulating the Branch on its interest and participation in the Southwest Regional Group and its being represented by individuals on national committees. He then reminded us that the AES is officially an educational society and stated that this was the basic consideration when the aims, goals and purposes of the organization are determined. His tracing of the organization through the Supreme Society, eight regional groups, fifty-nine branches, and eight thousand members gave weight to his statement that this is an organization which exerts an influence on every citizen of this country.

In mentioning the research carried on by the Society, Mr. Nichols pointed out that this was made possible through the support of the 354 Sustaining Members. In talking about the Branches and their functions, Mr. Nichols stated that one of the primary responsibility of each Branch was that of drawing new recruits into membership into the Society. He then touched specifically on the membership goals which have been set out for the Kansas City Branch. In conclusion he spoke of the outstanding success of the last National Convention in Los Angeles and told of the next National Convention coming up in Boston.

Severn Carlson, sales manager of the Circo Ultrasonics Corporation, was introduced by Librarian R. E. Loupee. Mr. Carlson's topic was, "Advantages and Limitations of Ultrasonics in Cleaning." After defining ultrasonics as being sound waves above the audible range, Mr. Carlson mentioned some of the common uses of ultrasonics such as flaw detection, dust dispersion, and metal cleaning. In use various types of transducers are used to convert electrical energy into mechanical energy. He then briefly touched on the various types of transducers, their limitations, and the advantages and disadvantages of each. In the metal cleaning applications, ultrasonics are used to assist present established methods. Mr. Carlson indicated that the once popular belief that

ultrasonics were a cure-all is now being dispelled and that industry is becoming aware that it is a valuable supplement to tried-and-proven cleaning methods. It can be used on all materials which carry sound waves such as metals, plastics, ceramics, and glass. The principle of cavitation works to make ultrasonic cleaning. In this principle, small bubbles are formed which implode and thus pull dirt off of a surface. In discussing the hazards which may be encountered in using this process, he mentioned that a product might be destroyed or damaged by ultrasonics if it were at the natural frequency of the sound waves being used. Ultrasonics have also been known to drive solutions into sealed containers. Mr. Carlson indicated his belief that most manufacturers are equipped in their own plants to make trial runs of possible applications and he strongly recommended that this be done when any application of this process is being considered. At the conclusion of his talk, Mr. Carlson answered the questions of members and demonstrated a small ultrasonics cleaning unit.

Robert W. Davis
Secretary

LANCASTER

Dunlap Tells Platers About Metallurgy

The regular monthly meeting was held at the Hamilton Watch Company in Lancaster, Pennsylvania, on Wednesday, November 9, 1960. There were 14 members in attendance. The speaker was **William Dunlap** and his topic was "What a Plater Should Know About Metallurgy."

The membership voted to accept the applications of two new members.

The next meeting will be held in the Harrisburg area.

Martin S. Frant
Secretary

LOS ANGELES

Weekly and Babcock Speakers; Convention Committee Applauded

The October 12 meeting was called to order by Los Angeles Branch President **Frank Virgil. Emmett Babcock** substituting for the sergeant-at-arms introduced the guests.

The first vice president submitted the names of two membership applicants. President Virgil accepted nine new members. **Don Baudrand** reported for the handbook committee. The educational committee of the AES praised the individual articles. *Products Finishing* magazine is also reviewing the handbook and Western Machine and Steel World requested 7C or more copies.

Tony Stabile then read the names of the National Convention Committee members who stood in place and received an ovation from the membership.

Tony Stabile, **Francis T. Eddy** and **George Hetz** were elected as Los Angeles Branch delegates with **Norman Painter, Emmett Babcock** and **Earl Arnold** as alternates.

The speakers for the evening, **Claude Weekly** and Emmett Babcock were introduced with Claude speaking on the preparation and plating of the printed circuit and Emmett elaborating on the design, application and requirements. A new record for questions from the floor was set following these two fine speakers as the meeting was not adjourned until 10:35 p.m.

R. H. Pooler
Secretary

LOS ANGELES

Bellinger Describes Conversion Coatings

In the absence of President **Frank Virgil,** the meeting was called to order at 8:15 p.m. by First Vice President **Emmett Babcock. Ozzie Griset** the sergeant-at-arms introduced six guests.

The chairman of the April 8, 1961 Technical Sessions and Dinner Dance, **Bill Thomas,** named his committee for this affair; **Harold Segerson, Don Baudrand, Dan Ross, Berry Blackburn, Gene Wyman, Burt Adams** and **Harold Wanamaker.**

Three men were introduced as having appied for membership in the Los Angeles Branch.

The first vice president accepted three new members.

Due to the proximity to Christmas, there will be no December meeting with our next meeting being January 11, 1961.

It was pleasant to learn that Don Bedwell is speedily recovering from a recent operation.

Don Baudrand, the educational chairman, introduced the speaker of the evening, **Kenneth P. Bellinger,** who gave a fine talk on conversion coatings. Slides of a statistical nature were used to augment his findings and questions from the floor rounded out another excellent meeting.

R. H. Pooler
Secretary

MIAMI

Rotoli Talks About Sequestrants

Earl Kennedy presided at the October 21 meeting. It was decided that there would be no formal business meeting during the month of December, because of the holiday season.

The next meeting of the Branch will be held at the Miami Skyways Motel.

By a unanimous vote, **Fred Fulforth,** who is an honorary member of both the National Society and the Miami Branch, was granted full voting rights in the Miami Branch.

The speaker of the evening was **An-**

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thony Rotoli, whose topic was "Sequestrants—What They Are and What They Do." The talk was most informative and led to a very lively discussion session.

A. Schorr
Secretary

MILWAUKEE
Pascoe, Steuernagel and Korbelak speak at December Meeting

The December 2nd meeting of the Milwaukee Branch was held at the Maryland Hotel.

Dinner commenced at 6:00 p.m. and the business session began promptly at 8:00 p.m. with **Walter R. Pascoe,** technical service manager of the Whirlclad Div. of the Polymer Corp., Reading, Pa. delivering a talk entitled "Fluidized Coatings."

Al Korbelak of Sel-Rex Corp., who is a recipient of an AES Silver Medal, followed with a talk on "Jet Age Precious Metal Plating."

Robert Steuernagel's five minute report on "The History of Job Shop Finishing" ended the business meeting.

Refreshments were then served through the courtesy of Electrochemical Products Company.

Clinton Host
Second Vice President

MOHAWK VALLEY
Tour Brewing Plant

The October 20 meeting, with an attendance of 50, was called to order by President **Robert Stewart** after an excellent meal provided by the West End Brewing Co.

He read a letter received from Past President **Jack Bension** who now resides in Florida and displayed a can of fresh sunshine sent by Bension to be used for a gavel.

Mr. Stewart welcomed the guests who were introduced by the members.

The secretary reported that 43 members were presently registered at Headquarters. He presented two membership applications which were duly elected.

A tour of the plant was the highlight of the evening and some similarities of equipment used by platers were noted. The composition and control of the various ingredients used was explained and it was pointed out that the abundance of pure and clear water from the Adirondack Mountains was a most important factor in brewing beer. It was noted that this company uses the largest volume of water of any of the industries in this area. We were amazed at the number and large size storage tanks used to age the beer properly, each one holding thousands of barrels. After noting the care and cleanliness of the plant the tour was ended by sampling the product provided by the company. It was enjoyed more than ever before.

Henry J. Crouse
Secretary Treasurer

NEWARK
Modjeska and Heineman Present Papers

President **John Banta** called the October 21 meeting at the Hotel Robert Treat to order at 8:30 p.m. About 50 members and guests were in attendance, including **Bill Quin** from Danbury and **Jim Quarl** from Bridgeport.

Secretary **Foulke** announced that the New York Branch AES plans to honor **Dave Clarin** on his forthcoming retirement. He urged us to attend this meeting, to be held Nov. 11, 1960 at the Hotel Statler in New York.

Three applications for membership were received, and six applicants were elected to membership. Three transfers into the Branch also were received.

Don Foulke announced that **Peter Arnold** was in an accident and hospitalized, and that **Jim Myron** was promoted to plant superintendent at Monroe Calculating Co.

Cy La Manna presented **John Heineman** of Oakite Co. whose Timely Topic was "Conversion Coatings." He briefly covered conversion coatings for all metals in general, and specifically for coatings on aluminum. He showed photomicrographs indicating that a metal possessed a smoother after coating than before. However, he claimed that this surface presented a better bonding surface for paint than the very coarse, irregular surface.

The librarian then presented **R. Scott Modjeska** who spoke on "Printed Circuits and Electroplating." Mr. Modjeska covered well the various pros and cons of plating printed circuitry. Some points of considerable merit which he mentioned were, that copper cannot, as yet, be recovered economically from etching solutions; that non-conductive templates have been made for plating through holes; but

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that while this is a good workable procedure, it is expensive.

He described briefly several methods for making flush printed circuits as well as to discuss flexible circuits. He suggested higher concentration sulfate copper baths and stated that he knew of one plant plating as rapidly as 500 amp/sq ft.

Mr. Modjeska's presentation was very interesting and enlightening. Both speakers were given a rising vote of thanks.

Gustav Bittrich
Assistant Secretary

NEWARK
Electroplating Course Planned; Ben Discusses Plating on Aluminum

President **John Banta** called the November meeting to order at 8:30 p.m. with 65 members and guests in attendance. The Branch was fortunate in having two distinguished visitors, namely **Manuel Ben**, Second Vice President of the National Society, and **Mr. Rose** from Melbourne Branch in Australia.

Secretary **Foulke** announced that **Dave Clarin** thanked the Newark Branch for the congratulatory letter which he received last Friday at the New York Branch AES meeting. Dave said that he always felt as if he were a member of both Branches and was indeed pleased at our thoughtfulness on his behalf.

The secretary then read off the names of twenty delinquent members, and asked their friends to contact them and remind them to bring their dues up to date. Don made an appeal to keep our membership active and strong in order to continue as the third largest Branch.

One application was received; and three were elected to membership.

Under unfinished business: the Christmas Party program was announced. **Cy LaManna** stated that the electroplating course is accepting enrollees up to January 7. The course will begin on February 7, 1961. **Ray Abazia** stated that he was having difficulty with publicity of the Branch activities, but will continue his efforts in this connection.

A moment of silence was observed for **Thomas Haddow** who passed away. Mr. Haddow was an honorary member of the Branch.

The meeting was then turned over to Cy LaManna who introduced Manuel Ben as the speaker of the evening. Mr. Ben expressed greetings to the Branch from **Fred Olmstead,** President of the Detroit Branch AES. He also complimented us on the success of our electroplating course and on our monthly news-letter "Sparks."

The evening's subject was "Plating on Aluminum." Mr. Ben briefly outlined the early methods of plating on aluminum. He then explained in great detail the methods used by General Motors for plating on aluminum as well as to discuss some of the more recent developments in plating this metal. His talk included also the corrosion of aluminum such as roof exposure tests, test details on taxis in the Detroit area, as well as the CASS tests.

He also mentioned that they are working on a process for plating on aluminum employing electroless nickel. The process has much merit, unfortunately he could disclose no details at this time.

The question and answer period which followed this talk was the liveliest one we have had for some time. Undoubtedly, the interest in this subject was very high. Mr. Ben was given a rising vote of thanks for a very creditable presentation and the meeting adjourned at 10:30 p.m. However, many lingered long after the meeting for further discussions with Mr. Ben.

Gustav Bittrich
Assistant Secretary

NEW YORK
Dyeing Anodized Aluminum Presented by Stiller

The October 28 meeting at the Hotel Statler was called to order by President **Joseph Rembecki.**

We shall have only one meeting in November. It will be held the 11th, and will be **Dave Clarin** Night. **Angelo Amatore** is working on the details.

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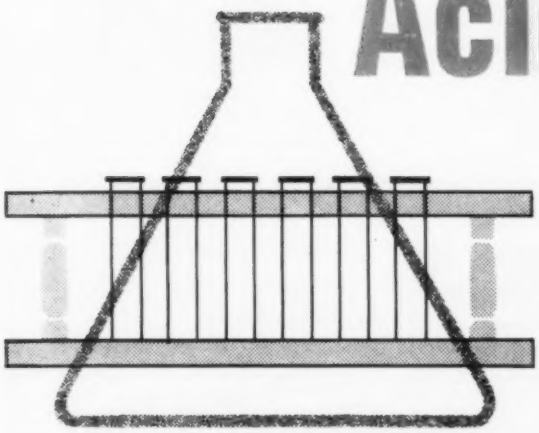

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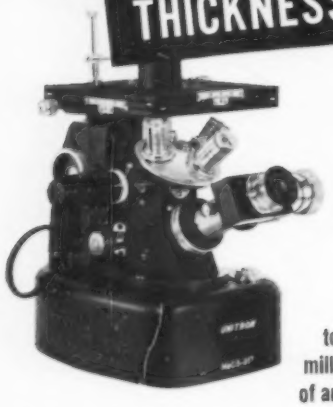

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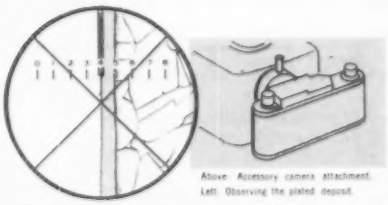

Above: Accessory camera attachment. Left: Observing the plated deposit.

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Librarian **Martin Pollack** introduced **Frank Stiller,** technical director of aluminum department of Sandoz Chemical Works. Mr. Stiller's paper "Dyeing of Anodized Aluminum" was very well presented. He covered the various methods used for anodizing aluminum and proper ways for dyeing same. Mr. Stiller, an expert in his field covered the subject very thoroughly, describing the various methods of sealing the colors and effects of sealers on the dyes used. He received a rising round of applause following the usual question and answer period.

Fred Saras
Recording Secretary

PHOENIX
Nobel Talks on Gold Plating

Our November meeting was held at the Arizona Ranch Home Inn at 5614 North Central.

After an excellent chicken dinner and anniversary cake, **Floyd Huhn,** president, opened the business meeting. One guest, **Tom Clow** of General Electric, was welcomed.

John Mullarkey gave a report on the plans for the Christmas Dance and everyone was urged to sell tickets. It was suggested that a letter be sent to all the wives inviting them to come.

After the business meeting, **Bob Hays,** Branch librarian, introduced **Fred Nobel** of Lea-Ronel who spoke on the subject "Bright Gold Plating." Many questions asked afterwards indicated great interest in the subject.

Paul M. Wible
Secretary

PROVIDENCE-ATTLEBORO
Voyda Gives Pointers on Anodes

The October meeting of the Providence-Attleboro Branch was held at the Engineering Society Building on October 17, 1960.

Speaker for the evening was **Theodore Voyda,** technical director of The Hubbard-Hall Chemical Co. of Waterbury, Conn. He spoke on anodes and their corrosion. In the course of the talk, he brought out the point that most of us pay little attention to anodes until trouble results and that this could be avoided by good housekeeping. Also that with all the different shaped anodes and hooks, the oldest shapes still appear to be the best for general all round work.

In the question period, **Pete Lonsbury** rose to thank Mr. Voyda for confirming what he had been telling us for years about anode hooks.

The speaker was excellent and the audience attentive which made for a fine evening.

Clifford I. Healy
Secretary

DAVID X. CLARIN HONORED BY AES'S MOTHER BRANCH
By Fred Saraso

Tonight (November 11, 1960) was "DAVID X. CLARIN NIGHT" in New York. Many old and new friends from the Newark and New York Branches turned out at the New York Branch Meeting at the Hotel Statler to honor Dave Clarin.

The meeting was called to order by President **Joseph Rembecki.** After roll call of officers, motion was made and carried to dispense with all business except applications for membership.

President Rembecki then read a letter from the Secretary of the Newark Branch to Dave Clarin praising him for his services to the AES.

Ralph Liguori spoke about the old times and Dave Clarin's work at the local and national levels of the Society. Dave Clarin started the Aunt Ella luncheons to entertain the wives of platers attending the National Conventions. Aunt Ella became famous, and the ladies always looked forward to the good times provided by Dave Clarin at these luncheons. Mr. Liguori then presented Dave with a transistor radio from the New York Branch. A plaque which was to be presented Dave will be sent to him at a later date.

Milton Nadel also described some of Dave's activities in the Society and presented him with an Honorary Membership to the New York Branch.

David X. Clarin

Dave then took the floor to thank all concerned with this night. He told the history of how the Aunt Ella luncheon was started, also remembering the good times had in past conventions.

Branch Librarian **Martin Pollack** then introduced **Tom Downey** of the Pfizer Chemical Corp. who spoke on "Organic Acids and their Salts used in Anodizing and Plating." Mr. Downey gave a very interesting talk and with the aid of slides described the application and function of organic acids and salts in Anodizing and Plating. Mr. Downey received a rousing round of applause following his talk.

After the meeting, the members and guests retired to partake in refreshments and review past experiences with the guest of honor Dave Clarin. A good time was had by all and we say to Dave, thanks from the bottom of our hearts for all you have done for us.

PROVIDENCE-ATTLEBORO

Bellinger Gives Talk on "Trouble-Shooting"

The November Meeting was called to order by President **Dan Turner** at 8:00 p.m.

At the short business meeting **Jerry Noonan** gave a progress report on the Christmas Party, held on December 12, 1960. Jerry has been in charge of this party for many years and has done an excellent job each time.

Dan Turner also appointed a committee to work with the University of Rhode Island in planning the annual Spring Plating Seminar. The members of the committee are: **Pete Lonsbury, Sibley Kershaw, Dr. Ed Parker, Granville Robbins, George Belcore, S. Lewis Doughty.**

The speaker of the evening was **Kenneth Bellinger,** president of Conversion Chemicals, Rockville, Conn. His subject of the evening was "Trouble Shooting in the Plating Room." He stressed the fact that good housekeeping is one thing that helps keep the service man from the door but that if the service man is called in he should use all the tactfulness possible. As he remarked, it may be that the clue to the trouble and solution of it can as often as not be found from the man working at tank.

Many other helpful points were brought out during his talk.

Clifford I. Healy
Secretary

ROCKFORD

Rockford Ladies Get Decorating Help

The Rockford Branch honored their ladies at the annual Ladies Night Dinner, held at the Holiday Inn, Rockford, Ill. on November 14. A record crowd of 85 ladies, members and guests enjoyed a fine dinner and an evening of good fellowship and fun.

In deference to the ladies, the usual technical talk was dispensed with and a very interesting discussion, "Color Begins With You" dealing with modern unity of color in home decorating schemes was heard. **Irma Dutrieux,** color stylist for the O'Brien Paint Corp., a recognized interior decorator, writer of color articles for leading home decorating magazine and guest teacher on color and its uses at the University of Oklahoma was the speaker. The talk was well received by the ladies as they consulted with Miss Dutrieux on individual home decorating problems for nearly two hours after the meeting. Wonder how many platers will have to do painting on Saturdays?

A short film showing the highlights and beauty of Boston was shown in an effort to promote family vacations in connection with the forthcoming convention.

Alexander Alexander
Publicity Chairman

ST. LOUIS

Saltonstall Presents Paper and Film on Agitation

The regular monthly meeting was held at the York Hotel with 40 present for dinner. There were 49 members and guests on hand when the business meeting was called to order. Six new members were elected on a motion by **William Piel** and a second by **Harry Reuter** that passed unanimously.

Mention was made that **Andy Julius** had been in the hospital and that **Ed Musick** had had a slight stroke. It was suggested a card or remembrance might cheer them up.

The meeting was turned over to our librarian who introduced the speaker of the evening, **Dr. Richard B. Saltonstall** of Udylite Corporation, who talked on Agitation in Plating Baths.

His talk was accompanied by a film on air agitation. There was an active question and answer period

Ward W. Kelly
Secretary

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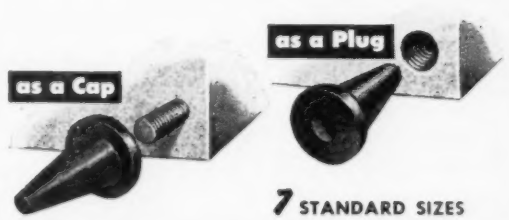

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SAN DIEGO
(Temporary Charter)

The nominating committee met on September 21 and selected the following slate of officers pro tem to present to the regular meeting on November 17: **Nick Carter,** president; **George Loch,** vice president and librarian; **Walt Dornbusch,** secretary; **Harry Steinke,** treasurer. Nominations will be invited from the floor.

The November meeting is to be held at Civic Center Cafe, 1533 Pacific Highway, San Diego. Dinner will precede the business meeting. A film on the History of Flight is to be shown. **Robert Bailey** and **Sam Witkoff,** both of the Quality Control Laboratory of Convair will present a paper on Quality Control in the Plating Industry.

Nick Carter

SOUTHEASTERN
Hohner General Chairman 1966 Convention; Saltonstall Speaker

The Southeastern Branch held its regular monthly meeting on November 11, 1960, 31 members and guests attending, **Myron M. Randman** presiding. Mr. Randman was welcomed back to good health as he made his first appearance since a recent lengthy illness.

It was announced that plans and reservations are being considered for the 1962 Dixie Regional Meeting which will be held February 12 and 13, 1962 at the Dinkler Plaza Hotel in Atlanta. A general chairman is not yet appointed. On the long range side it was announced that **Clem Hohner,** charter member and untiring faithful committee worker, has been appointed general chairman of the 1966 National Convention in Miami. Librarian **George Taylor** recognized Clem Hohner who in turn introduced the speaker for the evening, **Dr. Richard B. Saltonstall** of the Udylite Corporation who spoke on Air Agitation for Plating Baths. Platers from Greeneville, Tenn.; Athens, Ga.; Anniston, Alabama; Carrollton and Adel, Georgia; and Atlanta were very interested in Dr. Saltonstall's explanation of the pros and cons of all types of agitation.

Robert Probert

SYRACUSE
Winters Discusses Cadmium and Zinc Plating

The monthly meeting of the Syracuse Branch was held at the Turn Hall on Monday night, November 21.

After a short business meeting, an interesting talk was given by **John Winters** of Incar Inc., Cleveland, Ohio. Mr. Winters' subject was on "Cadmium and Zinc Plating at the Job Shop Level." The talk was followed by a lengthy question and answer period.

Refreshments were served, courtesy of The Incar Co.

Twenty-seven members and three guests attended the meeting. The guests were **Jack Little** and **Ed Perry** of Cleveland Branch and **John Siefan** of Detroit Branch.

Rene Sonnenfeldt
Recording Secretary

BRANCH EDUCATION

AT DAYTON

Early this year Dayton joins the many AES Branches fostering courses in Electroplating. A comprehensive evening course is planned.

L. A. Critchfield
Publicity Chairman

AT NEWARK

The Plating course sponsored by the Newark Branch will start on February 7 and continue through May 16, meeting every Tuesday from 8 until 10 p.m.

New subjects to be covered are electroless nickel and electroless gold, and tin and tin-alloy plating. The curriculum also includes fundamentals of plating and chemistry, chemical calculations, electrocleaning and pickling, cleaning and phosphate coating, barrel finishing, barrel plating, copper and nickel plating, chromium plating, cadmium and zinc plating, precious metal plating and trouble shooting.

Instructors are primarily members of the Branch. Classes are held in plants in the Newark area. The tuition fee is $25.00—text books are additional.

Full information can be obtained by contacting F. J. LaManna, Allegri Tech, Inc., 141 River Road, Nutley, N. J. Phone NOrth 7-3910.

AT PHILADELPHIA

In the current Fall-Winter class in Electroplating at Temple University Technical Institute, which is sponsored by the Philadelphia Branch with Dr. Samuel Heiman as instructor, there are forty-nine students, many of whom travel from such distant points as Harrisburg, Lancaster, Pottstown and Trenton.

Dr. Samuel Heiman
Instructor

PLATING MAGAZINE invites AES Branches to furnish news for publication in PLATING concerning electroplating courses sponsored.

WATERBURY
Weisberg Discusses Plating of Printed Circuits.

The Waterbury Branch held its regular monthly meeting at the Roger Smith Elton Hotel on Thursday, November 10, 1960. A report was submitted by the members of the Branch who attended the planning meeting for the 22nd New England Regional. Included with this report was a report concerning the Interim Meeting to be held in Hartford on February 11, 1960. The branch started a committee to select our "Old Timer" who is to be honored on the occasion.

Three new members were installed at the meeting.

Technical chairman **Robert Bair** introduced the speaker of the evening, **Al Weisberg** of Technic Inc. who spoke on "Precious Metals in Printed Circuits." Mr. Weisberg gave case histories from his experience and enumerated the troubles frequently encountered in the plating of printed circuits. He explained the process, its problems, and how procedures seemingly unrelated to plating eventually cause plating problems. It was an excellent paper well received.

The next meeting was to be held at the Roger Smith Elton on Thursday, December 8, 1960.

F. A. Schneiders
Publicity

WESTERN ONTARIO
Tour Northern Electric Plant

The November meeting was held at Hook's Restaurant, London where some 25 members enjoyed a delicious dinner. Plans were completed and tickets distributed for sale for the Annual Ladies Night Dinner Dance to be held January 20, 1961 in the William Pitt Hotel, Chatham.

After dinner the members journeyed to the Northern Electric Co. plant where **Ed Brown** had very carefully lined up a plant tour. Members of the staff welcomed the group, giving a brief outline of the company and its operations. The tour through the plant proved very interesting. Here the members had a chance to see automation at its finest; precision work, rigid inspection and different phases of operation that made this large plant operate. The plating department proved doubly interesting in that it was a plater's dream come true.

Coffee and sandwiches were served by the staff after which **Norm Southern** expressed the Branch's appreciation to Ed Brown and his company for the fine manner in which they treated the Western Ontario Branch.

Bob Dobson

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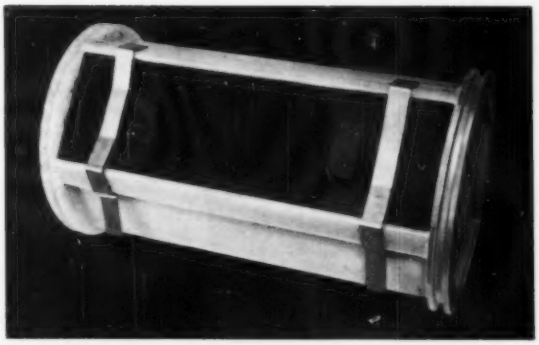
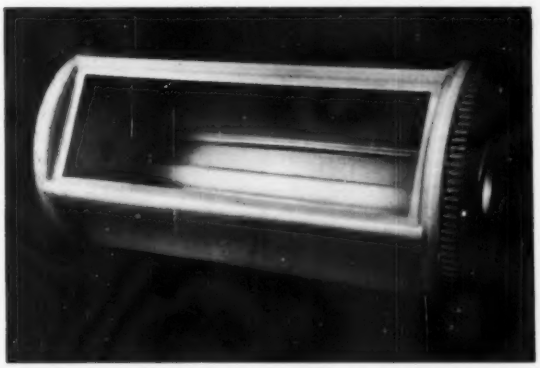


Horizontal barrel for belt drive. High-temperature Cycolac door is held by stainless steel clamps.



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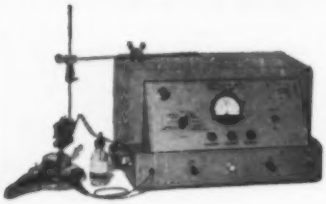

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AMERICAN ELECTROPLATERS' SOCIETY

January 20,	1961—**Western Ontario Branch,** Annual Ladies Night Dinner and Dance, William Pitt Hotel, Chatham, Ont.
January 21,	1961—**Grand Rapids Branch,** Annual Educational Session and Banquet, Symposium on Quality Control, Pantlind Hotel, Grand Rapids, Michigan.
January 27,	1961—**Research Committee,** Conrad Hilton Hotel, Chicago, Ill.
January 27,	1961—**Cleveland Branch, Annual Educational Session,** Technical Center, Cleveland Engineering Society, Cleveland, Ohio.
January 28,	1961—**Cleveland Branch, Annual Banquet and Dinner Dance,** Carter Hotel, Cleveland, Ohio.
January 28,	1961—**Chicago Branch Annual Meeting and Banquet,** Conrad Hilton Hotel, Chicago, Ill.
February 3-4,	1961—**Third Annual Dixie Regional Technical Session,** Hotel Roanoke, Roanoke, Virginia. Blue Ridge Host Branch.
February 4,	1961—**New York Branch Annual Educational Session and Banquet,** Hotel Statler-Hilton, New York, N. Y.
February 4,	1961—**Saginaw Valley Branch Annual Educational Session and Banquet,** Frankenmuth, Michigan.
February 4,	1961—**Seventh Annual Tri-State Regional Meeting,** Deshler-Hilton Hotel, Columbus, Ohio.
February 11,	1961—**Eighth Interim Meeting,** Supreme Society, Statler Hotel, Hartford, Connecticut. New England Regional Council, Host.
February 11,	1961—**"Old Timers Night," AES New England Regional Council,** Saengerbund Hall, Hartford, Conn.
February 18,	1961—**San Francisco Educational Sessions and Dinner-Dance,** Jack Tar Hotel, San Francisco, Calif.
March 3-4,	1961—**Philadelphia Branch Annual Technical Session and Banquet,** Benjamin Franklin Hotel, Philadelphia, Pa.
March 4,	1961—**Dayton Branch 15th Annual Educational Session and Dinner Dance,** Biltmore Hotel, Dayton, Ohio.
March 11,	1961—**Rockford Branch, Annual Meeting,** Rockford, Ill.
April 6-7,	1961—**Editorial Board Meeting,** Statler-Hilton Hotel, Detroit, Michigan.
April 8,	1961—**Los Angeles Branch,** Annual Educational Session and Dinner Dance.
April 14-15,	1961—**Executive Board Meeting,** National Headquarters, Newark, N. J.

FUTURE MEETINGS

April 15, 1961—Baltimore-Washington Branch, Annual Banquet and Dance. Presentation of the "Order of the Pot," Baltimore, Maryland.

April 22, 1961—Twenty-Second Annual New England Regional Meeting, Hotel Statler, Hartford, Conn.

April 24-25, 1961—AES Research Conference, Bell Telephone Laboratories, Murray Hill, N. J.

April 26, 1961—Research Committee Meeting, National Headquarters, Newark N. J.

April 29, 1961—Milwaukee Branch Annual Educational Session and Banquet, Schroeder Hotel, Milwaukee, Wis.

May 2, 1961—Central Michigan Branch Annual Educational Session and Banquet, Hotel Hayes, Jackson, Michigan.

May 5-6, 1961—Rochester Branch Fiftieth Anniversary Celebration Concurrently with Empire State Regional Annual Meeting, Hotel Manger, Rochester, N. Y.

June 18-23, 1961—48th AES Annual Convention, Hotel Statler, Boston, Mass.

January 13, 1962—Ninth Interim Meeting, Supreme Society, Hotel Marott, Indianapolis, Ind.

June 25-28, 1962—49th AES Annual Convention, Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

June 24-27, 1963—50th AES Annual Convention, Ambassador Hotel, Atlantic City, N. J. Sponsorship Newark Branch.

June 15-18, 1964—51st AES Annual Convention, Sheraton-Jefferson Hotel, St. Louis, Missouri.

June 16-18, 1964—Sixth Industrial Finishing Exposition, St. Louis, Missouri.

June 28-July 1, 1965—52nd AES Annual Convention, Statler Hotel, New York, N. Y.

June 1966—53rd AES Annual Convention, Hotel Fontainebleau, Miami, Florida. Dixie Regional Council, Sponsor. Southeastern Branch, Host.

INTERSOCIETY

January 24-27, 1961—Society of Plastics Engineers, 17th Annual Technical Conference, Shoreham Hotel, Washington, D. C.

Jan. 30-Feb. 3, 1961—American Society for Testing Materials, Committee Week, Netherland-Hilton Hotel, Cincinnati, Ohio.

March 20-24, 1961—American Society for Metals, 12th Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 30-May 4, 1961—The Electrochemical Society, Spring Meeting, Claypool Hotel, Indianapolis, Ind.

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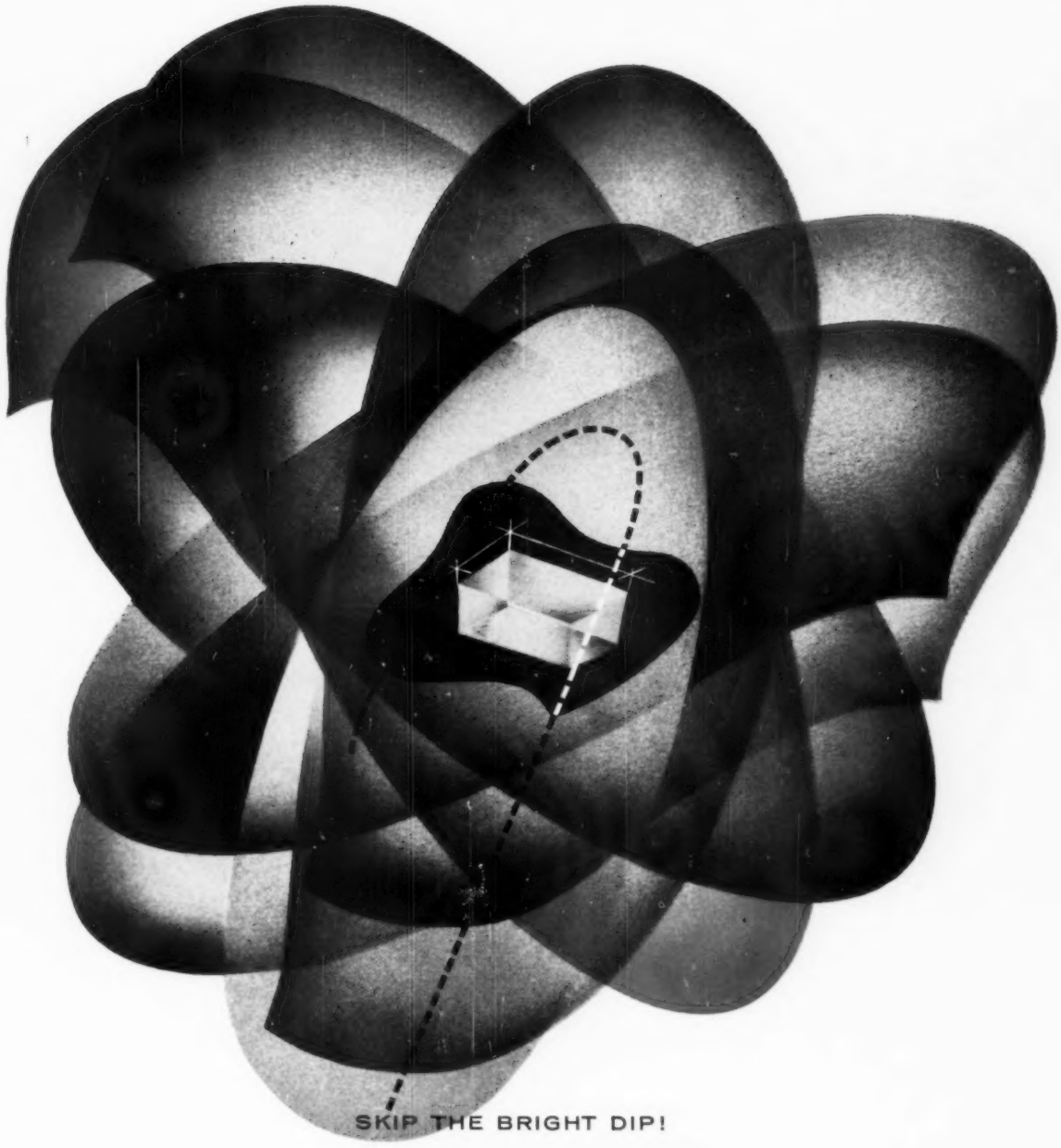

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